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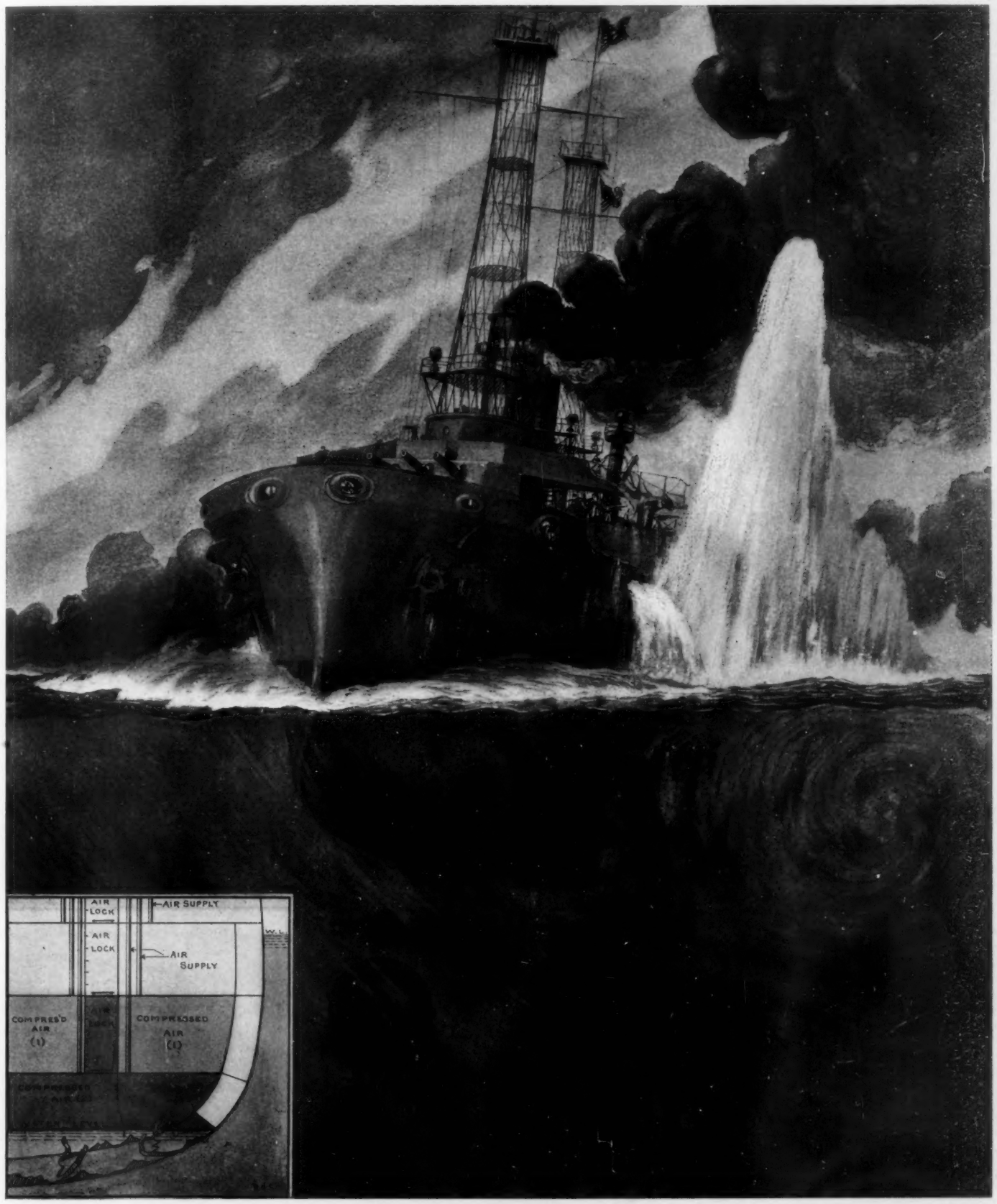

The small sketch shows the new method of expelling water from a warship by the simple expedient of forcing compressed air into the compartment affected.

PROTECTING BATTLESHIPS WITH COMPRESSED AIR.—[See page 266.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Control of the Mississippi River

THE volume of correspondence which has reached this office since the publication, on February 15th, of our editorial on the problem of the Mississippi River, proves that the magnitude and pressing importance of this question is appreciated not only by residents of the Mississippi Valley, but increasingly by the nation at large. We believe that before very long it will be understood that the regulation of a natural waterway that flows through the heart of the country is surely of equal importance to the construction, entirely outside of our borders, of an artificial waterway such as we have built at Panama.

We draw attention to a letter upon the general subject of Mississippi River control, printed elsewhere in this issue, which draws attention to the fact that those who are interesting themselves in the problem are to be grouped broadly into two parties—the one believing that it is possible to regulate the Mississippi by properly revetted levees, the other holding that the best results will be obtained by a combination of dams for the storage of floods at the head of the Mississippi and its tributaries with a system of levees in its lower reaches.

In the editorial referred to we stated that those who believe that it is possible to control the Mississippi by building vast reservoirs near its headwaters, have failed to appreciate the magnitude and cost of such reservoirs and the enormous areas of land that would have to be condemned for the purpose. It was shown that Government measurements, taken at the height of the recent flood, proved that at one particular point the river was flowing at the rate of 2,300,000 cubic feet per second—a maximum flow which is equal to twelve times the amount of water that passes over Niagara Falls.

These figures of total quantities are sufficiently large to prove that the regulation of the river by reservoir construction alone would be impracticable, even if the existing levee system were maintained at the present grade line. As between regulation by carrying the levees to a height that would absolutely control future floods, or building the levees to a lower height and constructing reservoirs to hold back a portion of the floor waters, there is of course a difference in cost and time of construction which could only be determined as the result of accurate surveys and estimates. We do know that the army engineers, with their long experience and a vast amount of accurate data at command, have made an estimate for complete control of the river by levees, of about $70,000,000 for the levee work and about $90,000,000 for the revetment to protect the levees, or a total cost for the whole work of $160,000,000. Whether it would be possible to make any serious reduction in this total by holding back a certain portion of the flood waters is a question, upon which it is foolish to engage in any mere guesswork. There is at least a strong suggestion that any reduction in cost so secured would be inconsiderable, in the statement of Col. Townsend before the House Committee, that if it had been possible to destroy the whole State of Minnesota, that is, hold back all the water that flows over it, there would not have been a difference of three tenths of a foot in the height of the last flood at Cairo. Furthermore, a reduction of three or four feet in the height of the flood by conversion of the St. Francis Basin into a storage reservoir, would have called for the sacrifice of some seven thousand square miles of country. Nevertheless, we believe it would be good policy to have estimates prepared as to the relative economies in time of completion, benefits conferred, and total cost, of a pure levee system as against a levee-and-reservoir system.

Referring to the statement of our correspondent that in the year 1717 a two-foot levee was ample to protect New Orleans from flood, whereas in 1912 twenty-two feet were registered at the same city, we wish to point out that the difference may be regarded as being in a certain sense an eloquent tribute to the industry of the American people, in bringing into subjection the virgin lands of the Mississippi basin. Two centuries ago the melting snows and heavy rains were retarded in their flow from the higher to the lower levels by vast forests and thickly interlaced underbrush which has since been cut down and cleared away; and the flow of suface and subsoil water into the streams has been facilitated by the open ditch and the subsoil drain. It is quite possible that if two graphic curves were developed, one representing the rate of popullization in the Mississippi watershed, and the other the increase in height and volume of the Mississippi floods, there would be found to exist a surprisingly close relation between the two.

What the Rich Man Might Do for the Scholar

BUILDING libraries is a favorite pursuit of philanthropists. This proves that many benevolent persons prefer to minister to the mental rather than the material needs of humanity, a preference with which we are not disposed to quarrel. Just because, however, we heartily approve of libraries, we deplore the fact that the amount of money spent in creating them is out of all proportion to the amount spent in making them useful. A library is still a library, even though its contents are securely locked up from human sight, as in the case of the precious manuscripts said to be stored in the crypt of St. Sophia, at Constantinople. The admirable science of librarianism, which has been mainly evolved within the past half century, has for its main purpose the removal of the invisible bolts and bars that obstruct access to libraries. Modern aids to reading and research, in the form of card-catalogues, indexes, bibliographies, and the like, have immensely facilitated the use of the great collection of books of which our civilization is so proud, but there is still an almost unlimited amount of work to be done in this direction.

Here is a suggestion for the rich man who wishes to vary the programme of library-building. A library is primarily beneficial only to a restricted community. The benefits of good work in the bibliography are universal. Why not endow a "bibliographic institute"?

Gustav de Laval

IN his book "Great Men," Prof. Wilhelm Ostwald makes a scientific study of the life-history of the great scientist as a specific type of man. There is no doubt that such men do represent a specific type, or perhaps rather a number of specific types. Gustav de Laval, whose death was recently announced, was a striking example of the typical inventor; a mind ever busy on the solution of problems, a man who solves problems because he cannot help himself. Thus it came that not all of his inventions proved commercial successes, and those that did, enriched others perhaps more than their originator. It has been estimated that the cream separator and milk tester devised by de Laval have saved billions of dollars to the world's dairy interests. As for the steam turbine, one form of which is known by his name, though the entire field was opened by him, its value to the world needs no emphasis here.

Gustav de Laval was born on May 8th, 1845, in Sweden, though, as his name implies, he comes of French stock, one of his ancestors having settled in Sweden after serving in the host of Gustavus Adolphus. De Laval early showed an inclination for mechanics, and his parents wisely directed his education toward an engineering career. He entered the technological department of the University of Upsala in 1863, and three years later graduated with distinction. Then came a short period of practical experience in an iron mine and with a waterworks builder, followed by a post-graduate course at Upsala, leading to the doctorate in 1872. Upon re-entering practical pursuits, he was sent to Germany to make a study of the manufacture of sulphuric acid, and upon his return to Sweden, he built the first sulphur burners in his country. Later he became constructing engineer at an iron works, where he introduced various improvements in galvanizing, the production of steel, and the extraction of phosphorus from iron ore.

The idea of the de Laval steam turbine came to him in the course of an experiment in sand blasting. The breaking loose of a steam jet was the fortunate accident which started the train of thought. An accident, also, it was that led him to his other great invention—the artificial cream separator. There was a large dairy on the iron works estate where de Laval was employed, and so, not unnaturally, the talk one day turned upon a new milk skimmer reported from Germany. It consisted essentially of a rotating barrel, in which the milk was placed. Centrifugal action hastened the separation of the cream, which was finally skimmed by hand as usual. This crude device formed the nucleus of de Laval's automatic centrifugal separator, in which the cream is discharged in a continuous stream from the rotating vessel. Such was de Laval's sense of honor that he refused to sell his invention until he had first given an option to the inventor of its crude prototype. As the latter, however, did not avail himself of this offer, de Laval proceeded independently with his own device.

De Laval was a great inventor; but he was more—he was a man of great character. His patriotism took the practical shape of services rendered to the State as member of the Lower and of the Upper House of the Swedish Parliament. From these activities he retired in 1896, finding that, after all, his best qualifications lay in other directions.

Sweden is justly proud of a noble list of great men, its sons. And in this list not the least is the late engineer and inventor, Carl Gustav Patrik de Laval.

Germany's Aeronautical Weather Bureau

THE first storm-warning service for aeronauts on a national scale was that established by the German government at the beginning of the year 1911, as fully described in the article "An Airman's Weather Bureau" in the SCIENTIFIC AMERICAN of July 29th, 1911, p. 98. This unique institution has now been in operation over two years, and has amply justified its existence. Its history up to date is given in the last annual report of the Lindenberg Observatory, at which the service has its headquarters.

Beginning with last year, in addition to the center at Lindenberg, a second central station has been maintained at Frankfurt-on-the-Main. The principal pilot-balloon stations are Aachen, Frankfurt, Hamburg, Magdeburg, Berlin, Breslau, Königsberg, and Bremen. These are provided with large balloons, capable of reaching an altitude of from 2½ to 5 miles (according to the size of the balloon) in about 40 minutes. Secondary stations, equipped with smaller balloons, are located at Bromberg, Dresden, Ilmenau, and Weilburg. Reports are also received from the independent aerological stations at Strassburg, Friedrichshafen, and Munich.

The telegraphic reports of upper-air observations received at the two central stations are combined with the ordinary low-level weather reports collected at the Deutsche Seewarte, in Hamburg, and enable the authorities to issue twice-daily forecasts which state in very definite terms the conditions likely to be encountered by aeronauts at various levels for a few hours in advance. The forecasts and warnings are telegraphed to all the co-operating stations, and warnings are also telegraphed or telephoned directly to individual aeronauts and institutions that request them and are willing to pay a small fee for this service, in addition to the telegraph tolls.

Probably the most important development of the aeronautical weather bureau since it was established is the system of reporting thunderstorms. At first the attempt was made to utilize the services of a number of the ordinary volunteer observers who report by post to the meteorological institutes. This plan was not successful, as a great many observers did not live near enough to the telegraph offices to send their reports promptly—and delays are fatal in an undertaking of this character. Accordingly, with the approval of the postal authorities, a new corps of thunderstorm observers was organized among the 2d and 3d class postmasters (who are also telegraphers). In 1912 the number of these observers, all of whom give their services voluntarily, was 608. In addition, 18 important offices in large towns, which are the centers of the main telegraph lines running in all directions, report disturbances on the lines indicating the occurrence of electrical storms. The fact that reports from postoffices are treated as "service messages" insures prompt transmission, which is further promoted by the fact that the Lindenberg Observatory has a private wire from Berlin. By these means German meteorologists appear to have solved the important problem of giving aeronauts timely warning of all thunderstorms that enter or originate in the Empire. Most of these storms move in a general direction from west to east, and frequently assume the form of line-squalls, i. e., long zones of disturbance moving sideways across the country.

All the important aeronautical events of the last two years in Germany, including the army maneuvers, have made the fullest use of the new weather service, and it is now looked upon as an indispensable institution.

Engineering

That High-speed Submersible.—The high-speed submersible, of large displacement, designed to fight head-on and "rush" the battle line of the enemy, discharging its torpedoes at point-blank range, has again made its appearance (in print) and this time it is credited to the German navy. A 25-knot, 3,000-ton submersible, with curved armored deck, rushing at a battleship across the 10,000-yard range, would be difficult to stop before she came within close torpedo range.

One Thousand Horse-power Diesel Engine.—As an instance of the large powers in which the Diesel engine is being built, we note that two 1,000 horse-power, two-cycle, four-cylinder, Carels-Diesel engines are to be installed in an Arizona mining property and that these engines are to deliver 1,000 horse-power at an elevation of 6,500 feet, the consumption not to exceed 0.48 pound of oil per brake horse-power per hour.

Test of an American Diesel Oil Engine.—After the publication of so many tests of the performance of European-built Diesel engines, it is interesting to study the records of a 225 horse-power Diesel engine, built by the Busch-Sulzer Engine Company of St. Louis, and tested by Prof. A. T. Scott. The engine had been in service six months, and no preliminary tuning up was attempted. The records show a fuel consumption of 10.8 gallons of oil at quarter load, 6.8 at half load and 6.2 at full load, or 0.441 pound of oil per net brake horse-power per hour. The thermo-dynamic records based on net useful output showed 17.4 per cent at quarter load, 27.8 per cent at half load and 30.3 per cent at full load. The results certainly speak well for American Diesel oil-engine practice.

The Needs of the Navy.—In a letter to the New York *Times*, the outgoing Secretary of the Navy, George v. L. Meyer, made a succinct statement of the needs of the United States Navy. He stated that the battleship fleet should be maintained with 21 ships in the active fleet and 20 in the reserve fleet. The former should not exceed ten years of age, and those between ten and twenty years old should be placed in reserve. We should have four torpedo-boat destroyers for every battleship, in addition to scout cruisers, submarines, supply ships, colliers, and minor auxiliary vessels. The building programme each year should be sufficient to replace those battleships which have reached in each year the limit of twenty years of age.

Piece of Rope Wrecks the "Lusitania."—The "Lusitania" has the telemotor system of steering gear, in which the movements of the steering wheel in the pilot house are transmitted hydraulically to the steering engine, several hundred feet away. The falling of a small piece of rope or twine into the rack of the telemotor caused the same to bind and jam the steering gear. This took place just as the "Lusitania" was entering Fishguard harbor, and was about to turn to port to avoid a steamer. When it was found that the telemotor had jammed, an order was given to reverse the turbines at full speed. The strain proved too great for the blades of the turbines, which became twisted out of their proper pitch. It was found that over one million blades would have to be replaced, and the cost of the repairs will run up to several hundred thousand dollars.

Dock Commissioner Tomkins on 1,000-foot Piers.—In the opinion of Dock Commissioner Tomkins, no new 1,000-foot piers should be built above 46th Street (as was recently suggested by the Board of Estimate and Apportionment) but all such piers should be built south of the Chelsea district. He states that the cost of rock excavation at the site above 46th Street would, alone, exceed $4,000,000 per pier, and the time for building would be not less than four years. There may be some truth in what the Commissioner says, but we do not believe that either the cost or the time of construction would be so great as he states. According to his statement, a 1,000-foot pier could be built at the lower end of Manhattan Island in two years' time for a cost of less than $1,000,000. We are of the opinion that the piers in the lower section of the river should be built first, but that the site above 46th Street should be secured to provide for future contingencies.

Risk of Torpedo Maneuvers.—The loss of a German torpedo-boat destroyer with sixty-six officers and men—practically the whole complement—illustrates once more the grave risks of night maneuvers, when carried out by these craft in connection with battleships. In the particular maneuver in which the disaster occurred, the group of destroyers, in line abreast, passes through a column of battleships. It requires the nicest judgment of speed and distance to enable the captain of a destroyer to carry his boat through the interval between two battleships, which may be steaming at 15 knots or more, without being rammed. A slight misjudgment may bring the craft square across the bows of the big ship; and this is what seems to have occurred in the case of the recent disaster. The Germans are fond of this maneuver and similar accidents occurred in July, 1912, and in September of last year. These, however, are the risks which must be run if high efficiency in maneuvers is to be maintained.

Science

An Important Change in the Map of Asia has recently occurred. The vast region of Mongolia has ceased to be a part of China, and is now independent. The Mongols are chiefly famous in the world's history as invaders and conquerors in Asia and eastern Europe. They were vassals of the late Manchu dynasty, but not of the Chinese government, and their separation from China resulted automatically from the proclamation of a republic. Their secession from China was aided by Russia, which thus secures a "buffer state" on its Chinese frontier.

Vertical Component of the Wind.—W. Peppler has published the results of observations made at Lindenberg Observatory on vertical air movements, as deduced from variations in the vertical speed of pilot-balloons and sounding-balloons. The average rate of ascent of the balloon for each 500 meters was compared with the average for the whole ascent. It was found that an increase in horizontal air movement was accompanied by an increase in vertical movement. The author obtains from his observations the important general law that vertical displacements of the air occur from levels of smaller to levels of greater horizontal velocity.

A Novel Educational Experiment has been in successful operation for some time at McComb City, Miss., according to a bulletin of the U. S. Bureau of Education. An arrangement has been made between the school authorities and the Illinois Central Railroad whereby boys may work every other day in the railroad shops, and on the alternate days attend the high school. They are known in the shops as "student-apprentices" and receive a minimum wage of 12 cents an hour. By this plan the boys not only pay their way through school, but at the end of the four-year high school course are able to draw a man's pay at a trade, in case they do not find it feasible or desirable to proceed to the university.

C. G. S. Units in Meteorology.—The vehement discussion that has been going on among meteorologists for about six years as to the desirability of making certain radical changes in meteorological units, especially those used in upper-air research, is likely to culminate at the forthcoming meeting of the International Meteorological Committee (April, 1913). The most important change proposed is the substitution of the "bar" and its submultiples for the units now in use for expressing atmospheric pressure. The bar is a pressure of 1 megadyne per square centimeter, and corresponds to a reading on the barometer scale of 750.1 millimeters, or 29.531 inches. Barometric readings would, accordingly, be expressed in millibars, or thousandths of a bar. A dynamic unit of this kind would undoubtedly be convenient for mathematical use in certain physical investigations, but whether its general adoption is feasible or even desirable is a grave question. Unless adopted universally—a step that would necessitate the reconstruction of existing barometers all over the world, and the conversion of a colossal body of records, tables, etc.—its introduction would simply lead to the existence of three kinds of units in place of the two—metric and English—which are now in use (and which are one too many!)

The German Antarctic Expedition, under Lieut. Filchner, recently returned to Buenos Aires, without having accomplished its chief purpose, which was to land in Antarctica and push into the interior of that continent. After traversing a belt of drift ice, 1,200 miles wide, new land was found in February, 1912, at latitude 76 degrees 35 minutes south, and longitude 30 degrees west; i. e., part of the shore of Weddell Sea, and evidently a southwesterly continuation of Coats Land. In honor of the late ruler of Bavaria, the patron of the expedition, this land was named "Prince Regent Luitpold Land." (Why not simply "Luitpold Land"? Antarctica is sadly burdened with needlessly long names.) The general course of this land was traced as far south as 79 degrees. In latitude 78 degrees an ice-barrier was discovered, extending west from the coast, and was named "Kaiser Wilhelm Barrier." A landing was effected on the barrier and a station established; but soon afterward part of the ice on which the station stood was broken off by a high tide, and the explorers had to regain their ship as best they could. The vessel then turned homeward, but on March 9th was caught in an ice-floe, and drifted helplessly until November 26th, when it was finally extricated by blasting. During this long drift oceanographical and meteorological observations were carried on. Weddell Sea was found to be shallow near the barrier, but very deep (about 17,000 feet) in the middle, and separated from the Atlantic Ocean by a ridge or rise, with a depth of about 3,300 feet. The currents seem to be controlled by the winds attending a quasi-permanent barometric depression overlying Weddell Sea. During the same drift an eight-day sledge expedition was made to the westward in an unsuccessful attempt to find the conjectural Morell Land. The expedition had the misfortune to lose its sailing-master, Capt. Vahsel, who succumbed to heart disease on the outward journey. The equipment of the party is reported to be intact, and another attempt to effect a landing in Antarctica will be made next December.

Aeronautics

A New Cross-country Speed Record.—On March 4th the French aviator Guillaux, who has recently made new speed records when carrying a passenger, flew in his 70 horse-power Clement-Bayard, all-steel monoplane from Savigny-sur-Blaye to Paris, a distance of 118 miles, in one hour, thus breaking all records for speed across country. On February 12th he made records of 391.9 kilometers (243.5 miles) in 4 hours, and 410 kilometers (254.8 miles) in 4 hours, 10 minutes and 46 seconds over a 10-kilometer course when carrying a passenger. His average speed was more than 62 miles an hour.

The St. Cyr Institute.—Regarding the Aerotechnic Institute of St. Cyr, near Paris, which we recently illustrated, the annual report shows that even at the start there were fifty-two demands for tests of aeroplaue surfaces and the like, or for information on allied subjects. The large laboratories, testing halls and experimental tracks under Prof. Maurain's direction are well adapted for this work. Among others, researches were made upon propellers at various speeds. Capt. Riviere also tested small models of propellers with the blowing machine. Profs. Toussaint and Lepere made tests upon recording instruments which are designed to be used on aeroplanes during the flights.

A New Altitude Record of Nearly 3¾ Miles.—At the Buc Aerodrome, on March 11th, M. Perreyon, on a Blériot monoplane, succeeded in reaching the tremendous height of 6,000 meters (19,685 feet). He thus beat the records of Legagneaux (5,450 meters or 17,880 feet on September 17th, 1912) and of Garros at Tunis (5,610 meters or 18,400 feet on December 11th, 1912) by a wide margin. The atmosphere is only about half as dense at these great heights as it is at the earth's surface. Not only does this affect the lifting power of the aeroplane but it reduces the horse-power of the motor as well, so that it is doubtful if a machine will ever be able to climb to a height much greater than four miles. Then, too, there is the difficulty in breathing, and it will be imperative for the aviator to inspire oxygen.

From France to Italy by Hydro-aeroplane.—The first hydro-aeroplane trip from one country to another was made on March 4th, when MM. Laurens and Schneider, on a Deperdussin monoplane, traveled from Beaulieu-sur-Mer to Genoa in 1 hour and 52 minutes running time, or but 5 minutes more than the time made by Garros alone in the Paris-Rome race of 1911. Although the sea was calm, the aviators claim they experienced air holes. A leaky gasoline tank caused them to stop at Spotorno, where they were long delayed. The flight was started at 8:45 A. M., and Spotorno was reached in an hour. After resuming the flight at 5:20 P. M., 49 minutes sufficed in which to finish it, despite the fact that from Sestri Ponente the machine was run on the water on account of fog. The hydro was moored to a battleship and the aviators received an ovation.

Monoplanes vs. Biplanes for Military Use.—Last year a number of accidents happened to monoplanes at the commencement of the British Army maneuvers, with aeroplanes of different types, so that the War Office decided to forbid their use by the officers, and at the same time appointed a commission to look into the matter of comparative safety of monoplanes and biplanes, as it was claimed that the former were more dangerous. The commission has now published its report, and it appears that nothing justifies the idea that the accidents are due to any special class of aeroplanes, but come only from lack of care in assembling the machines. In general, the tests made by the experts seem to show that biplanes are not any more stable than monoplanes, and it is to be remarked that many pilots prefer to use the monoplane as it is simpler and is less fatiguing to handle. Several points are recommended which should be looked after in both classes of flyers, one of these being an increase in the stay wires so as to give greater strength. Landing on the ground should be done gradually, and not in a sudden descent, as this is a source of danger.

A Height Record.—The young head pilot of the Farman School at Etampes, Pierre Gougenheim, recently made a brilliant performance, breaking the record for height with five men on board, in spite of the fact that a very strong wind was blowing at the time. At 7 A. M. the 80 horse-power Gnome-motored Farman biplane left the shed and took on the pilot and four men, and at 7:10 A. M. the aeroplane started up easily in spite of the heavy load and then made evolutions about the aerodrome. At 8:05 A. M. it reached an altitude of 750 meters (2,461 feet), but then a shower commenced and this prevented him from going any higher. He descended under good conditions and alighted on the ground with ease in front of the hangars. The above height was found recorded on the barometer. The world's record for five persons had been held by the Belgian Berschaeve with 596 meters (1,955 feet), but this is much distanced at present. The flight was checked by the Aero Club's delegate. What is remarkable is that the velocity of the wind was 35 miles an hour, and the pilot had great difficulty in overcoming the air resistance caused by the four persons. He used a huge Farman biplane having a spread of 56 feet.

How the hood collapses into the frame of the body.

The queer, rounded protuberance at the rear serves as a storage receptacle for spare tires.

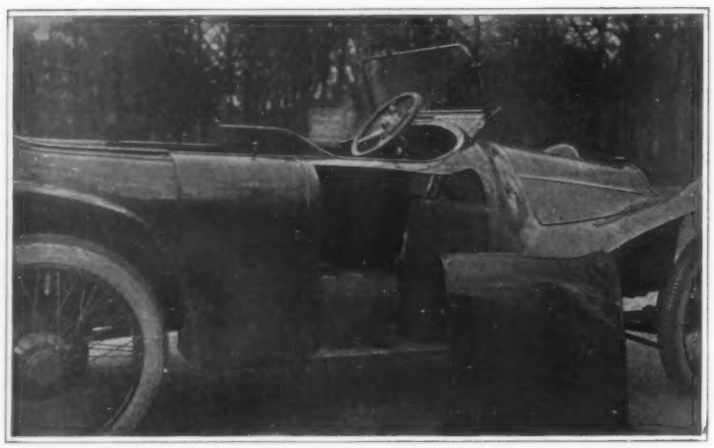
The frame of the hood fits into the lines of the car.

Freak French Automobile Bodies

IN the SCIENTIFIC AMERICAN for March 1st, 1913, we published an illustrated article on some remarkable automobile bodies which have recently made their appearance in France. On this page we publish some additional views which will reveal the purpose of the curious bumps and ridges that have undoubtedly attracted the attention of our readers.

The accompanying engravings tell their stories so lucidly that it is almost unnecessary to add any text. Suffice it to say that the tendency is becoming increasingly manifest both in this country and abroad to produce automobile bodies which, like the hull of a ship, shall be as free as possible from excrescences and protuberances. Tool chests, gas tanks, tire cases and all the other impediments of the running board will eventually be concealed. The running board itself will disappear. In the Purcat-Mery car, the Griffault body has manifestly been designed with this purpose in view. The old running board becomes the bottom of a casing in which luggage can be stored. Tires are concealed in the rounded protruding rear end of the car. The hood is made so completely collapsible that even its frame disappears, becoming or rather literally melting into the lines of the body. The headlights become part of the mud-guards.

While we cannot altogether admire the car as it is revealed in our illustrations, it would be idle to deny that an important step has been taken in departing from the traditional type of automobile body—a type which as we still manufacture it bears unmistakable evidence of having descended from the old horse-drawn pleasure vehicle.



The old mudguard becomes the bottom of a casing for the storage of luggage.

Six Wheeled Omnibus

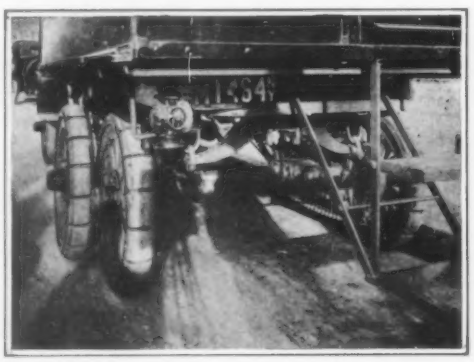
By Stanley Petman, M.E.

WITHIN the past few weeks there has appeared on the streets of New York a motor omnibus mounted on six wheels. The vehicle is similar to those used in the streets of London, which were designed by Henry B. Molesworth, the first man to introduce the bogey truck construction in road vehicles. However, the New York omnibus differs from Molesworth's in several important respects.

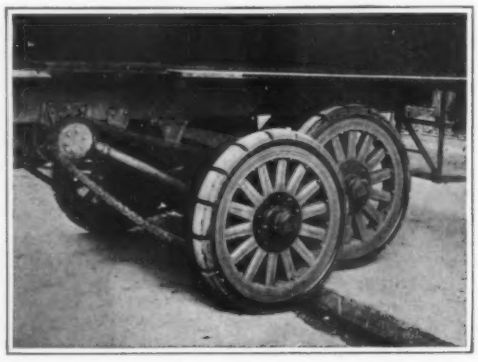
Molesworth's principal object was to obviate side-slip, which up to the time of his invention had been the bane of the manufacturer's life, due probably to lack of experience in the construction of heavy vehicles and also in part to the peculiar work for which the 'buses were intended. In this new vehicle, the reduction of side-slip has been made a secondary object and follows as a natural result of the greater tire surface in contact with the road. The prime consideration was to increase traction and reduce vibration.

In Molesworth's omnibuses there are three pairs of wheels, one pair being at the front as usual, and the other two pair being at the rear; the arrangement was much the same as that depicted in the accompanying picture. There is this difference, however: Whereas Molesworth drove only the center pair of wheels and steered with both of the other pairs, in the latest arrangement both the rear pairs of wheels are driven and the vehicle is steered by the front ones only. Which arrangement materially simplifies construction as a matter of course, for it eliminates the necessary complexity which must arise when any attempt is made to steer the two outside pairs. Incidentally, it cheapens construction, while at the same time permitting a higher factor of safety due to the better disposition of the metal and the absence of the multifarious joints otherwise necessary.

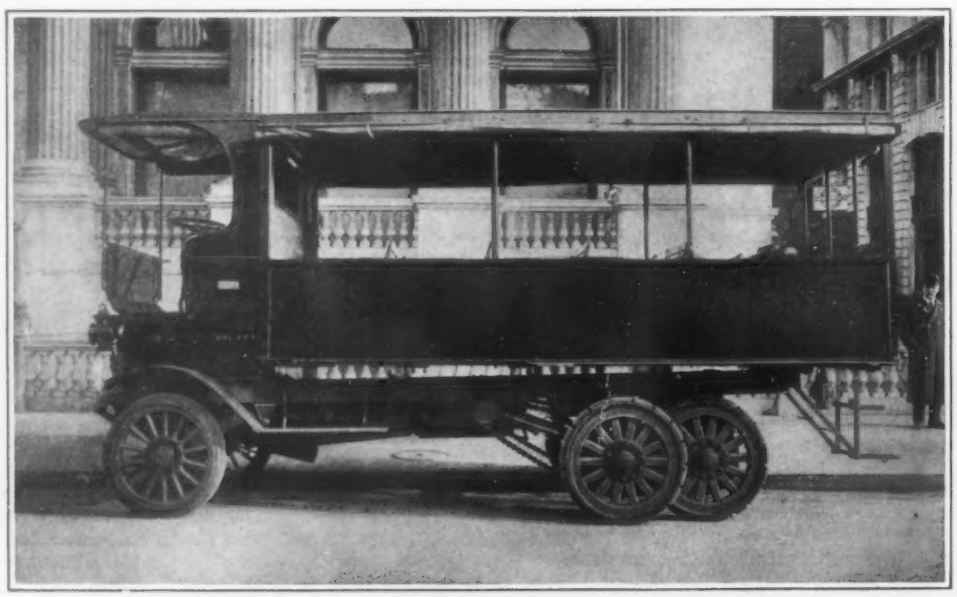
The new vehicle is standard with the exception of its rear axle, which, as may be seen, really is two rear axles, carrying two pairs of wheels. These two axles, however, are very short, being scarcely more than stubs, and are mounted at the ends and integral with what are termed "equalizing bars," the latter being hinged to the main axle which extends the width of the vehicle. The "equalizing bars" are in effect levers of the second class, whose arms, are of equal length and partake of the functions of these devices; which is to say, when one end of the lever is elevated, as is shown in the accompanying picture depicting the vehicle with one pair of the wheels on the road surface and the other pair on the curb, the total vertical movement transmitted to the main axle is only half that sustained by the end of the lever. The net result of the arrangement, of course, is that a great amount of vibration due to irregularities in the road surface is eliminated.



View showing chain connection of the two pairs of rear wheels.



Flexiblity shown by backing the rear wheels upon the curb.



Six-wheeled motor omnibus recently introduced in New York.

The drive is transmitted from the engine through the intermediary of a master clutch and an orthodox gear set to a jack-shaft and thence to the front pair of rear wheels through side chains. From the front pair, side chains transmit the drive to the rear pair. As both pairs are equipped with brakes, the brake capacity is double.

The inventor claims that as the two pairs of wheels are smaller individually than would be the single pair, the added cost is purely nominal and need not exceed $100. This, it is pointed out, would be more than offset by the saving in tires, because twice the surface is in contact with the road as would be with the ordinary vehicle.

The second objection is based on the difference in direction of the pairs of driving wheels when the vehicle is turned sharply. But as the distance between wheel centers is short—in practice it is 25 inches—the actual amount of difference in direction is small at best and is more than compensated for by distortion of the rubber tires.

Stereoscopic Views of Lightning

By the Berlin Correspondent of the Scientific American

IN the year 1887 the Royal Meteorological Society of England addressed a circular to photographic societies and individual photographers throughout the world requesting them to furnish the society with photographs of lightning flashes. About sixty photographs were secured, and an examination of them made possible the first accurate classification of the forms of lightning. In 1889 Mr. Marriott, assistant secretary of the society, published a set of rules for photographing lightning. The same year Weber, in Germany, and Hoffert, in England, independently devised a method of analyzing a compound lightning flash, viz., by the use of a camera revolved slowly in a horizontal plane. This was an immense improvement upon the non-photographic methods—entailing the use of various forms of the revolving disk—which had led earlier investigators, including Arago, Dove, and O. N. Rood, to conclude that many lightning flashes are multiple, and had enabled them to form a rough idea of the intervals between the successive discharges along an identical path which gives such lightning a flickering appearance. Moreover, in 1889, A. W. Clayden, in England, cleared up the mystery of "black flashes" in lightning photographs by his discovery of the "Clayden effect."

Since 1889 the progress of lightning photography has been due chiefly to improvements in the technique of the moving camera. One of the pioneers in this field was A. Larsen, whose work has been done under the auspices of the Smithsonian Institution. (A full account of Larsen's researches was published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1635, May 4th, 1907.) The most successful applications of this method, however, are due to Dr. B. Walter of Hamburg, who has made comparative studies of lightning flashes and analogous electric discharges in the laboratory. The greatest improvement introduced by Walter in the photographic process was the addition of a stationary camera, installed alongside the moving camera. A comparison of the two pictures thus obtained enables the investigator to determine the exact relation in time of the various phenomena photographed. The first account in English of this double-camera method and its results is that given in Mr. C. F. Talman's article, "New Ideas About Lightning" in the SCIENTIFIC AMERICAN of June 29th, 1912. (The reader should examine especially Fig. 2 of the article just cited in connection with what is said below about the use of the moving camera.)

Walter's latest achievement involves the use of a third camera, as stated below. The photogrammetric method in lightning photography is not altogether new; it has been applied by McAdie, in this country, among others. Its use in connection with the moving camera, however, represents an important advance. To complete this hasty sketch of the history of lightning photography it may be added that the feat, once deemed impossible, of photographing lightning flashes in the daytime was achieved with remarkable success last summer by A. Steadworthy, of Ottawa. Moreover, the present writer has seen the negative of a still earlier photograph of daytime lightning, by L. Gimpel of Paris, made by *color photography*. Lastly, it should be stated that there is still a great deal of work to be done in lightning photography, and any competent person who takes this subject up is likely to be rewarded with some interesting discoveries. Several peculiar forms of lightning have not yet been photographed. "Beaded"

(Concluded on page 275.)

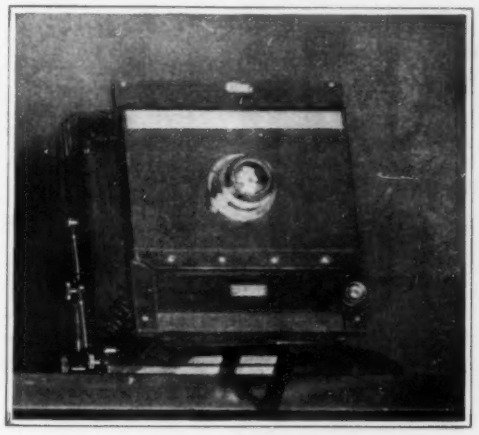


Fig. 1.—Stationary stereoscopic camera.

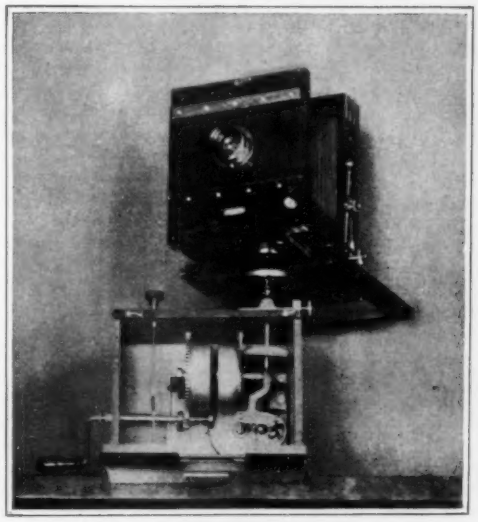
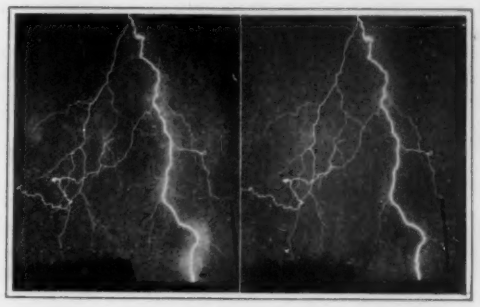


Fig. 2.—Movable camera with clockwork.



Figs. 3 and 4.—Stereoscopic pictures of lightning flash taken by two stationary cameras.

Fig. 5.—The same flash taken by a movable camera.

"The Snow of the Penitents"

By C. F. Talman

THE traveler in the higher Andes of Argentina and Chile is sometimes greeted with the startling sight of what appears to be an innumerable throng of kneeling white-robed figures upon the barren mountain side. The nearest known human habitation is scores of miles away; the region to which the traveler has penetrated is one in which, on account of altitude, a polar climate prevails, and mountain sickness afflicts even the hardy pioneer. In short, no more unlikely spot could be found for the orisons of this fantastic company.

Closer inspection dispels the mystery—only to replace it with another. Each of the figures is found to be a block of snow or ice, but wrought into forms such as are hardly assumed by frozen water in any other part of the world. The resemblance of the figures to human beings engaged in some solemn religious ceremony has led the natives of South America to call these strange hummocky snow-fields *la nieve de los penitentes*—"the snow of the penitents"—an expression that is often shortened to *nieve penitente*. The Germans, with their characteristic aversion to exotic terms, have translated this name to *Büsserschnee*, but English writers have been contented with the Spanish form.

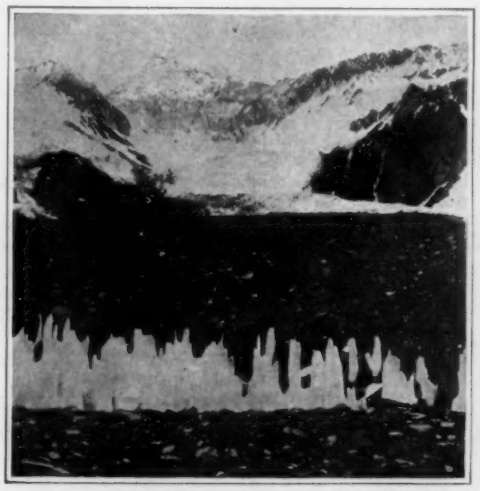
How does Nature fashion these grotesque figures? And why are they found only in a limited region of the Andes? These questions have not yet been satisfactorily answered.

The *penitentes* occur only in low latitudes; hence under a sun that is almost vertically overhead, at least part of the year. Perhaps it happens that a sheet of new fallen snow is of uneven density; then the powerful solar rays will speedily form depressions around the denser spots. As the snow continues to melt, the water trickling down from the mounds helps to deepen the hollows, as it is prevented from accumulating in the latter by the slope of the mountain. The arrangement of the figures in regular rows is also explained by the slope, the water all draining in one direction.

Perhaps the first impulse to the formation of mounds and hollows is given by the wind, which, as everyone must have observed, often blows the surface of a field of snow into waves and ripples.

There is another possible explanation. A well known experiment of Benjamin Franklin was to lay bits of cloth of various colors upon the snow on a sunny day;

Foot of Mount Tupungato.



Polleras I Glacier.

Rio Blanco Valley.

The "Snow of the Penitents" (Nieve Penitente) of the Chilean-Argentine Andes.—(Photographed by Dr. F. Reichert.)

he observed that the cloth soon became heated and sank into the snow, the darker-colored pieces sinking more rapidly, on account of their greater power of absorbing solar radiation. Patches of dust would have the same effect. Dust is found even on the highest mountains, most of it probably coming from the disintegration of the meteors which are constantly entering our atmosphere from outer space. The wind might easily blow a layer of this dust into a sort of checkerboard pattern, and then it would, when heated by the sun, honeycomb the underlying snow. Pinnacled snowfields arising from one or another of these processes are found not only in the Andes, but in the Alps and the Himalayas, and probably elsewhere. However, travelers who have seen the *penitentes* claim that they are quite distinct in appearance from the snow hummocks seen on other mountains, in which case they must be conditioned by some local peculiarity that has not yet been explained.

The photographs accompanying this article were taken by a leading authority on *nieve penitente*, Dr. F. Reichert, of the University of Buenos Aires.

Compressed Air as a Protection for Battleships

By R. G. Skerrett

THE serious consequences of a stumble upon a submarine mine, the chance, perhaps, of having one of our superdreadnoughts placed pretty nearly *hors de combat* by a single subaqueous blow, led our naval authorities to undertake a novel experiment more than a year ago. That experiment constituted the equipping of the armored cruiser "North Carolina" with a self-contained salvage outfit by which compressed air was to serve as the medium by which the inrushing seawater could be quickly driven outboard again and the damaged compartments substantially drained a few moments after an accident.

The test equipping of the "North Carolina" has proved so satisfactory in a number of ways that this system is to be installed henceforth as a regular feature upon the mightiest ships of our battle line, and this is especially the case with the peerless "Pennsylvania."

Mr. W. W. Wotherspoon is the engineer inventor of this system, and this application of it is really the outcome of his work in connection with the last effort to salve the cruiser "Yankee." The prime idea of the scheme is to turn each watertight compartment into a caisson, as it were, and by the admission of compressed air first to push the water out from the wounded chamber and then to keep it out by a sufficiency of compressed air. In other words, each compartment becomes like an inverted tumbler in a bucket of water—the tumbler being filled before inversion. Then by forcing air in through a hole in the bottom of the glass the water is expelled. In the case of a ship, however, the water enters by a wound in the bottom plating through one cause or another, and steps must be taken immediately to offset the stresses of this leakage before the gathering pressure ruptures the confining bulkheads. By the ordinary procedure, the ship's pumps try to hold the invading water in check, but, not infrequently, this is tantamount to trying to pump out the whole sea. Even so, the dividing walls of steel may slowly yield and the vessel is frequently doomed.

By Mr. Wotherspoon's system, not only is the inrushing water forced outboard again, but the surrounding bulkheads are given immediate and temporary support; which effectually localizes the injury. He accomplishes this by putting his heaviest air pressure immediately in contact with the water to be expelled; next he surrounds the injured space with air of lesser pressure; and, finally, he takes the excess of pressure from these supporting compartments by admitting air of still lower pressure to other flanking and superposed compartments. Thus by a successive distribution and reduction of the tax, none of the bulkheads or decks is overstrained. This idea of dividing the internal body into succeeding layers or strata of compressed air is one of the unique features of the system. For all ordinary contingencies, the highest pressure would not exceed 14 pounds to the square inch, and the lowest pressure would be in the neighborhood of about 4 pounds to the square inch. We have shown in the small diagram two strata of different pressures, and have marked them 1 and 2.

At first blush, it may be imagined that the installing of a system of this sort would involve a goodly increase of weight and much additional apparatus. As a matter of fact, the whole equipment is remarkably simple and easily put in place. This is because Mr. Wotherspoon has taken advantage of other fixtures that are already a part of the modern fighting ship. Every compartment is provided with two lines of piping; one to force fresh air into the space and the other to provide an exhaust for the foul air or gases. These pipes have to be strong enough to withstand certain pressure limits, and these limits are considerably in excess of Mr. Wotherspoon's requirements. He merely takes such of these pipes as he may need and connects them to a supply of compressed air. Pretty nearly every man-of-war—certainly all of the big ones—have air compressors aboard for other purposes, and a reserve can very easily be stored in a suitable reservoir and at a very high pressure. Therefore, all that is necessary to meet an emergency is to connect the ventilating pipes of any of the compartments with the compressed air in reserve and then to start the compressors in order to maintain a further supply. The facility with which a flooded compartment can be drained and the pressures in the supporting spaces brought up to the proper degree has been convincingly demonstrated in actual service, both in cases where the flooding has been intentional and where a leaky sea valve has produced the trouble.

According to the building specifications, every watertight compartment of a fighting ship is supposed to be tested at some time during the course of its construction; but because of the complex get-up of these craft and the early installing of some of the mechanisms, it is practically out of the question to flood these compartments. Accordingly, these spaces which should be watertight are sometimes not so, and the fact is not realized until accident perhaps reveals that disturbing fact. This is not all. The seatings of watertight doors become imperfect by use, and the extent of this weakness is frequently overlooked, and leakage might be of grave measure should the contiguous space be inundated. Mr. Wotherspoon's salvage system provides incidentally an effective means of testing every compartment and every watertight door at any time, and makes it possible to do this without damage to the contents of any of these spaces. The practical value of this inspection agency has been amply demonstrated, and it is helping our builders to do their work more intelligently and more thoroughly. In a number of cases where flanking compartments became flooded, compressed air was turned into neighboring spaces filled with valuable stores, and the water held away effectually.

A logical development of this safeguard against the foundering of a wounded ship is that of suppressing or smothering fire. For such a contingency, Mr. Wotherspoon again makes use of the ventilating piping, but instead of forcing compressed air into the endangered division, he pumps down through the pipes a volume of non-inflammable gas. Carbon dioxide has been tried for this purpose before, and this has been drawn from the smokestack, but this is not desirable, and in fact is not sufficiently available in quantity in the cases of oil-burning craft. Therefore, Mr. Wotherspoon will use another gas which can be quickly generated in large quantities. This gas will not damage stores or merchandise. The advantage of a check on fire of this nature must be fully apparent, and one can easily see the losses thus avoided instead of using water. Apart from this, water is not always an effective extinguisher, whereas a suitable non-inflammable gas is when made to fill a confined space wherein there is a fire. The suppressing of fire upon a man-of-war is pretty nearly as vitally important as that of promptly arresting a leak, in fact, there are times when this may be a matter of desperate concern.

Revelations of the Boston Automobile Show

NOW that the last of the really big automobile shows is over, the doors of the annual Boston exhibition having been closed this week, and manufacturers at length can draw breath free from the apprehension of show cares, it is meet to take stock of affairs by way of ascertaining if possible just wherein the benefit of such expositions lies. Probably the true state of affairs never will come to light, though an extraordinarily clear vision scarcely is needed to see that the automobile show as a show has almost, if not quite, outlived its usefulness.

It long has been known that these annual functions cause unrest in the bosom of the manufacturer. Similar symptoms in the bosom of the dealer are only rendered less acute by the hope of increased sales—some day. To the dealer, however, that some day does not come now as it did in the past; it does not come of shiny cars exhibited together under a common roof where the human spirit of restlessness and curiosity induces constant search for something newer to look at or to occupy a mind already cloyed with too much newness and too much gloss. Cars are not sold that way now.

It is a comparatively well known fact, to salesmen at least, that satisfactory sales from his own point of view and from the point of view of the purchaser demand comparative quiet, freedom from blaring bands and a more suitable atmosphere than that afforded by the automobile show. Hence, the dealer does not, as a rule, hail the show with delight. It disrupts his sales and service forces, just as it disrupts the sales and engineering forces of the manufacturer As a matter of cold fact, it was only after heated argument, and as a measure to prevent unscrupulous promoters stepping into the breach that would be left, that it was decided to hold the usual shows in 1914. Whether they will be repeated in 1915, which is quite a long way to look ahead, remains to be seen, but if present sentiment can be taken as an indication, the repetition is unlikely.

The public wants the shows, of course. They furnish excellent excuses for the display of the family jewels and permit practice in polishing up the manners that go with manifold social doings. But the car-buying public cares naught for such things in the majority of cases. Hence, the influence of the automobile show in increasing sales is questionable, to say the least.

Similarly, as exhibitions pure and simple, the shows which logically are for the exploitation of new wares fall far short of the average expectation. Cars which are shown already have been on the market for several months in nine cases out of the proverbial ten and little—very little—actual novelty is revealed. At the Boston exhibition, for instance, there were just five brands of cars out of a total of some hundred makes on view that had not previously been shown either in New York or in Chicago. Two were gasoline propelled, two were electrics and one was a steamer. It is almost the last of all the steamers, by the way, and its continuance in these days of steadily increasing efficiency is all the more remarkable by reason of the fact that its engine consists of two simple cylinders and that no condenser is used.

In the realm of accessories, the Boston show was no more productive of newness than it was in the realm of complete cars. Two engines appeared, heralded as being new, though in both there was apparent plain indication of well-known principles. In one the valves are in the form of reciprocating crescents outside the cylinders proper, and in the other the usual poppet valves are replaced by longitudinal rotating sleeves which alternately cover and uncover cylinder ports. In neither, however, has the designer given evidence of deep thinking with regard to the likely effect of unequal cylinder distortion due to the presence of irregularly shaped castings with comparatively large masses almost directly at the spot where the greatest heat is generated.

The single really significant feature of the show was in the form of a magnetic gear shifting device with which one of the cars was equipped. Pressure on any one of a series of five buttons, corresponding with the four forward speeds and one reverse speed, permitted any of the gears to be enmeshed without further exertion on the part of the driver than the release of the clutch. In view of the widespread adoption of electric lighting and engine starting devices and the general tendency toward the elimination of manual work, the presence of this device may well be viewed as significant, particularly inasmuch as it now is pretty well established that at least one well known American car will be equipped with a device of the kind before the end of the present year.

The Current Supplement

THIS week's issue of our SUPPLEMENT brings the concluding instalment of Mr. Wadsworth's report to the Inventors' Guild.—Much time may be saved, and efficiency gained, by employing judicious methods in sketching machine designs preparatory to the execution of complete drawings. Mr. Ford Harris gives our readers some valuable hints in this matter.—Dr. E. J. Russel of the Rothamstead Experiment Station, gives us a survey of the present views regarding the effect of soil sterilization upon plant growth.—Mr. F. I. Coleman tells us how the Hwang Ho, the world's most treacherous river, which has changed its course nine times in 2,500 years, has been recently spanned with a railway bridge.—Mr. A. S. Neumark contributes an excellent article on Peroxides and Persalts.—Mr. E. Oberg, in a richly illustrated article, describes the process of wire drawing.—Mr. F. Carnegie reports on a study of the vibrations of rifle barrels carried out by the aid of instantaneous photography.—Dr. R. C. Osburn gives us an interesting talk on the Crayfish. It is not generally realized that this crustacean has considerable food value, yet the annual catch in the United States amounts to $34,000.—An Extract from Lloyd's Official Report for 1912 will interest those of our readers who follow the development of the world's shipbuilding.—A comment on the Friedmann treatment for tuberculosis should prove of timely interest.

Old Tires Make Successful Splashguards.—As the result of a series of splashguard trials which recently were held in Paris, it is interesting to note that some of the most successful devices employed were merely old outer casings split and fastened to the rims of the wheels. On the whole, the tests served to make plain that circular guards arranged to control splashing to a fore and aft direction were most efficacious in protecting pedestrians.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Buggy as a Destroyer of Roads

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Arthur C. Brady is in the right in his article in your issue of January 18th, 1913.

I have made the same observation during many years, being led to do so by my work as a teacher of surveying and engineering.

Horses do most damage to the roads, and narrow steel tires come next. Any gravel or stone road in Indiana bears evidence of the above. Unless the former is dragged in suitable weather, which may not occur during an entire season, it soon has three deep grooves, two for the wheels and one midway between, formed by the horses, driven single. The last is most difficult to control. It is due mostly to rapid driving. On hills, where the horses walk, it is not formed.

Our farmers complain of automobiles ruining the roads, but the man in a buggy, with his fast-stepping horse, is a greater menace. There would be greater complaint if in taxing vehicles to raise a road fund, the horse-drawn buggy should be given its just share, and speed limited to four miles per hour, a rate that would do but little damage to the road. So far as I know, that has not been done in any State. The autoist is taxed because they think he is able to pay. In most cases he is also willing, greatly to his credit. While that is true, the facts as to road wear ought to be understood.

C. A. HARGRAVE.

Danville, Ind.

Spring Wheels

To the Editor of the SCIENTIFIC AMERICAN:

Referring to article by Mr. Domis which appeared in your correspondence column in the issue of March 1st, I wish to state that it was my intention in my previous communication to point out a principle which must necessarily be involved in any spring wheel, whatever may be its construction.

Mr. Domis's statement that "the highest type of spring wheel requires all of the springs to assist equally at all times in carrying the load" is correct. But it is evident, if we consider any given spring, first in a position below the hub and second in a position over the hub, that the flexures of the spring in the two positions must necessarily be in opposite directions, and of amounts equal to the flexure produced by the load, thus giving a normal flexure in each direction at every turn of the wheel.

The normal load flexure and the shock-absorbing capacity of the wheel will each be inversely proportional to the strength of the springs. It therefore follows that if "when the wheel is operated over a perfectly level road the springs are not flexed in the least degree," then the shock-absorbing quality of the wheel has been reduced to a minimum by the great strength of the springs.

The question involves a mechanical principle on which I had hoped to obtain an unbiased opinion, more particularly as to whether the present high quality of spring steel was capable of withstanding such a great number of flexures.

G. F. FISHER.

Plainfield, N. J.

Machining Granite Blocks

To the Editor of the SCIENTIFIC AMERICAN:

In the correspondence column of the February 22nd issue there is a request that you call the attention of the inventors of the country to the need of a machine to make granite paving blocks; and in acknowledging it you state that "it should not be difficult to devise suitable machines for doing this work."

After years of experiment with different machines, that failed to do the work in competition with hand labor, we certainly would be glad to hear of any such machine and could use scores of them. Further than that, any plan presented that seems feasible we would consider and would finance the construction of such a machine and pay liberally for its use.

We would appreciate the name or names of any firm, inventors, or otherwise to whom this proposition might appeal, so that we could take the matter up with them direct.

Chicago, Ill. WISCONSIN GRANITE COMPANY,
Per WATEN S. PRIMLEY, Treasurer.

Shaping Granite Cubes

To the Editor of the SCIENTIFIC AMERICAN:

In your correspondence column, February 22nd issue, page 174, headed "Required, a Machine for Shaping Granite Cubes," I read something that seems simple.

In 1900, at Providence, R. I., I saw a planer similar to that used in the machine shop for planing metal, planing granite slabs with a tool also similar to that used on the same kind of planer in the machine shop. A pipe with water coming out of it moistened the tool, drop by drop, as the stone passed slowly beneath. In another part of the shop a granite column was being turned in the lathe. I would suggest that the work could be done just as readily on cubes as on slabs, and that the job would depend upon the speed used only. I would also suggest that the job could be done in an economical manner on the ordinary machine-shop profiler or vertical milling machine with a fly cutter. This would be faster than the planer, as no time is lost in the return motion. The fly cutter is made up of a disk having several inserted tools, which may be removed when necessary to grind. The disk turns in a horizontal plane. The cube could be held in the ordinary vise chuck, and a stream of water or oil used to keep the tools cool. The speed should be no faster than what the tools will stand; the depth of cut and feed would be determined by the breakage of the particles of stone. A faster method yet would be to use a vertical grinding machine or surface, as used in the machine shop, using a very coarse wheel. It would then be a simple problem in abrasives, which the Norton Emery Wheel Company of Worcester, Mass., could no doubt solve for you in a very few hours.

Pittsfield, Mass. ALAN A. MCALLAN.

Audible Railway Signals

To the Editor of the SCIENTIFIC AMERICAN:

In regard to the matter of an "Ideal Automatic Train Control," on which a correspondent writes in your issue of February 15th, I would like to suggest that as to avoiding passing a signal set at danger, the absolutely certain method of invariably precluding this (so long as the block system is in order) is very simple indeed; namely, instead of visible signals have audible ones; for instance, instead of an arm being thrown into a certain position at the side of the track, arrange a trip in the track, which when set at danger, automatically would ring the bell of the engine, or a special one for the purpose, or blow the whistle in some peculiar way, say a half-minute-long blast, so that not only the engineman but the conductor and other trainmen, as well as passengers, could plainly hear the danger signal, and if the train was not immediately slowed down to a "walk," or stopped by the engineman, the conductor or some one else on the train would be sure to see that the train was soon slowed down in obedience to the signal; for "self-preservation is the first law of nature."

Such an audible-signal system could probably be installed much cheaper than an automatic-stop system, which must necessarily be complicated and expensive and would therefore never be generally adopted, and which is open to various other objections, such as sometimes stopping a train with dangerous suddenness at a turn, causing excessive "wear and tear," getting out of order too easily, etc. Some objections to the present visible-signal system are, that they cannot be seen at all in a heavy fog, the enginemen get tired of looking for them, and it has been proved that there are times when a person with ordinarily good color-sense is unable to distinguish red from green because of a severe cold, lack of sufficient sleep, ill health, or other causes for the brain not acting clearly. None of these objections, however, apply to the audible-signal system, which must eventually be universally adopted; and it is strange, indeed, that it has not been preferred long ago. A simple, inexpensive form of it could be made that would ring a bell electrically (but preferably intermittently) in the cab of the engine, thus dispensing with the mechanism operating a block-signal arm or a trip at the track-side; and of course the less expensive a signaling system is, the more generally will it be used. Every mile of railroad track should be provided with audible danger signals—the only efficient ones; and in this age of invention there is really no more need of having railroad collisions than for doing without railroads altogether. In conclusion, the present visible-signal systems could doubtless easily be changed to audible.

Livermore, Cal. ELMER G. STILL.

[Many of the existing automatic-stop devices are equipped with means for sounding an audible signal in the cab.—EDITOR.]

Alternative Propositions for Control of the Mississippi

To the Editor of the SCIENTIFIC AMERICAN:

Recently you printed an editorial in support of levees as a method of flood prevention and in opposition to anything else. Beyond the shadow of a doubt that editorial created a wrong impression among some of your readers, and for that reason I ask that you print this statement of fact in order that the issue involved be made clear.

Two schools of thought and two sets of men are now engaged in an effort to induce the Federal Government to solve the flood problem.

One set—the old-school thinkers—are domiciled at Memphis under an organization entitled "The Mississippi Valley Levee Association."

The other set—the new-school thinkers—have been, for more than a year, domiciled at New Orleans under an organization entitled the "National Reclamation Association," which was formed as the National Irrigation Association" in June, 1899—nearly fourteen years ago.

According to Mr. John Fox, secretary-manager of the Mississippi Levee Association, which is advocating a continuation of the "Levees Only" policy, his organization has secured "the enthusiastic support of all the railroads interested in flood protection."

The National Reclamation Association, which is advocating the nationalizing of the river by the Federal Government, and the control of its floods by the Federal Government, through the building of levees and revetment of caving banks, supplemented by the control of the source streams in order that levee-breaking floods will no longer be permitted to form, has enlisted in support of its campaign more than 1,000 business men, manufacturers and taxpayers, but no railroad, or corporation affiliated with the power-site promoters, is contributing to, or in any way helping, the work of the National Reclamation Association.

In the Salt River Valley of Arizona, the Federal Government has constructed the great Roosevelt Dam, which gathers the freshet waters of the Salt River, conserves them, and uses them to irrigate the arid lands of a large territory. Below the dam the Salt River is now peaceful and quiet. The Roosevelt Dam is an illustration of the character of source stream control provided for by the Newlands River Regulation Bill, and advocated by the National Reclamation Association.

Down in the Lower Mississippi Valley, near Vicksburg, Mr. John M. Parker has named his great 16,000-acre estate the Roosevelt Plantation. In May, 1912, through the breaking of the Salem levee, this estate was turned, by the river, into a mighty reservoir, with enormous loss to the owner and to many other owners of land in an area hundreds of square miles in extent.

The Roosevelt Dam Reservoir, in the Salt River Valley, is an illustration of a source stream reservoir; the Roosevelt Plantation Reservoir, in the Mississippi Valley, is an illustration of a crevasse reservoir which the river makes for itself when the floods are uncontrolled at their sources.

Under the terms of the Newlands River Regulation Bill, its appropriation and working machinery are supplemental to, not substitutes for levee work provided for or to be provided for through the Rivers and Harbors Bill.

During the Congress just terminated six million dollars were secured for the Mississippi River between Cairo and the Gulf.

The lowest estimate yet made of the cost of leveeing and revetting the banks of the Mississippi between Cairo and the Gulf under the standard of the Mississippi River Commission is $140,000,000.

Should the "levees only" people succeed in getting the $40,000,000 asked for by Senator Ransdell, $100,000,000 additional would be required, under the estimate, to complete this one angle of the work, an angle which deals with effect and not at all with cause.

The Newlands Bill provides this additional $100,000,000, and it also provides enough money to largely control the flow of such tributaries as the Ohio and the Missouri by controlling the source streams of these tributaries, in this way conserving much of the now wasted freshet waters and turning them to use for industrial purposes, and at the same time aiding materially in checking the formation of great levee breaking floods.

In 1717 a two-foot levee was ample to protect New Orleans from floods.

In 1912 twenty-two feet were registered on the river gauge at New Orleans.

During these two hundred years the valley has known no protection against floods other than that supplied by levees which invariably broke in some places whenever the increasingly great floods were poured down on them by the tributaries above.

Nobody down here is opposing levees, but many people down here have awakened to the fact that levees alone will not keep the river off the farms, and they are now asking that the Federal Government not only build good levees and properly revet the caving banks, but that it supplement this protection by harnessing the source streams wherever possible, thereby, in part at least, reducing the volume of floods by using some of the now wasted freshet waters for the creation of hydro-electric power, for the irrigation of dry lands, and for the feeding of the streams in the dry season in order that there will be water on which to float boats.

WALTER PARKER.

Measuring the Flow of a Stream

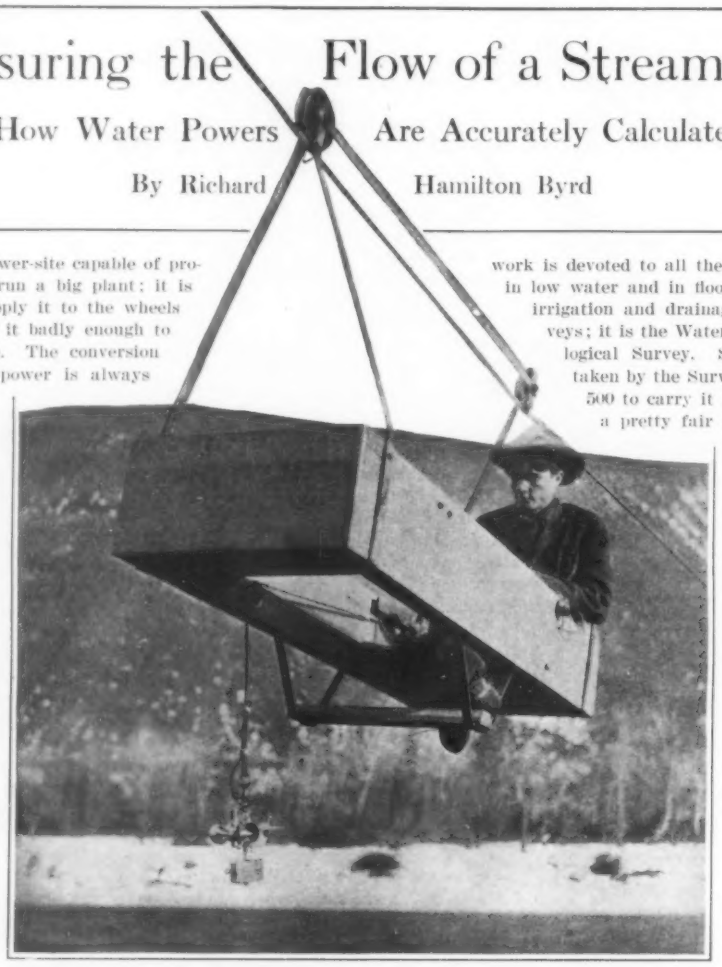
How Water Powers Are Accurately Calculated

By Richard Hamilton Byrd

IT is one thing to own a waterfall or a power-site capable of producing sufficient hydro-electric power to run a big plant; it is another thing to develop this power and apply it to the wheels of industry or to find some one who wants it badly enough to pay the owner what he considers it worth. The conversion of falling water into cheap merchantable power is always a large and most expensive undertaking. It is true that certain large corporations have of late years been acquiring water-power properties of great extent, but that the major portion of the water-power that can be generated in the United States is controlled by a few individuals or combinations, as has been freely stated, is not to be credited. The power which is at present running to waste in the navigable rivers alone of the United States, which are of course controlled by the Government, is much greater than all the power that has thus far been developed or projected, to say nothing of the millions of untouched horse-power in the rivers flowing through the public lands of the West which have been reserved by the Federal Government. The chief hydrographer of the United States Geological Survey estimates the developed water-power in the United States to-day in round numbers at 6,000,000 horse-power; but he believes the undeveloped water power which might be realized from the normal flow is 66,000,000 horse-power. Further, he estimates the possible ultimate development through the building of flood storage reservoirs at the tremendous total of 200,000,000 horse-power. It is thus seen that even with the enormous developments which have been going on in recent years we are but at the threshold of our water-power development, having so far utilized less than one thirtieth of this resource.

To obtain a mind picture of what this power means it may be reduced to terms of operating locomotive engines. There are in the United States about 51,000 locomotive engines, and the average engine has approximately 1,000 horse-power. The annual consumption of all the railroads is about 90,000,000 tons of coal. The maximum power from all the streams of the United States would, therefore, operate four times the number of all the locomotives of the country if they were running day and night every day in the year, or would do the work about twelve times greater than that actually performed by all American locomotives or represent a consumption of over a billion tons of coal a year—double our coal consumption of last year. While these are enormous figures compared with the actual power development to date, there is nevertheless intense interest throughout the entire United States at the present time in the value and the possibility of the country's waters and their utilization for power, for irrigation, for navigation, and for municipal purposes. What study is being made of the great resource in connection with any of these vital problems? What information, if any, is available to the owner of a water-power to enable him to determine the equity of the price offered?

There is a branch of the Government service whose work is devoted to all these matters—study of the volume of streams, in low water and in flood, current velocity, gradient, storage, power, irrigation and drainage possibilities—in fact, it makes river surveys; it is the Water Resources Branch of the United States Geological Survey. Since such work was systematically undertaken by the Survey in 1895 Congress has appropriated $2,032,500 to carry it forward, and the result is that we have now a pretty fair working knowledge of most of our principal rivers and many tributaries. In some years over 1,000 stream gaging stations have been maintained in most sections of the United States. This season the Survey has approximately four hundred such stations in operation, and is doing co-operative stream measuring with States and individuals at as many more.



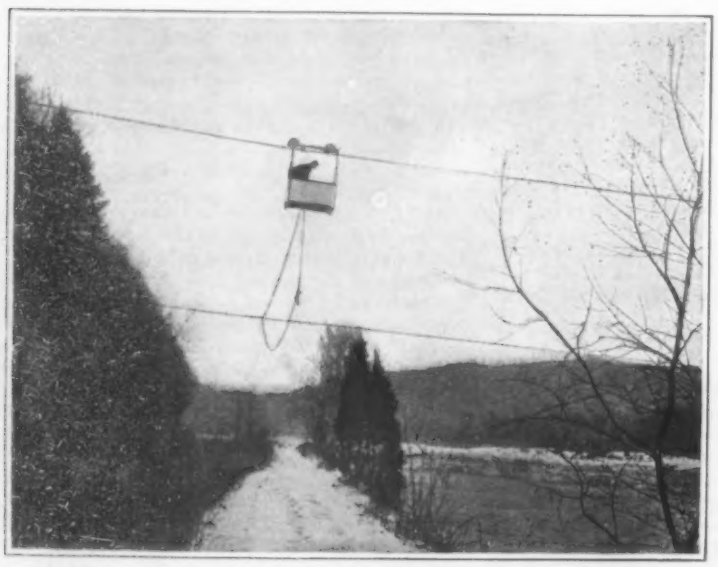
Gaging car and United States Geological Survey engineer on the Yakima River, Washington.

TABLE SHOWING IN SECOND-FEET THE FLUCTUATIONS IN FLOW OF EIGHT REPRESENTATIVE WATER-POWER RIVERS IN 1903—A TYPICAL NORMAL YEAR.

	Maximum.	Minimum.	Mean.
Susquehanna	276,000	5,600	47,500
Potomac	99,600	2,000	12,480
Housatonic	25,700	550	3,000
Savannah	130,000	3,400	13,900
Chattahoochee	15,400	415	1,690
Grand (in Colorado)	17,900	400	2,700
Sacramento	131,000	4,800	13,900
Columbia	903,000	72,200	236,000

In the contemplated development of a stream for power, irrigation, or any other industrial purpose the first question that arises is "What is the flow, the volume, of this stream?" How much water will it deliver in a day, in a month, in a year, in a period of years? To what extent can it be depended upon as a never-failing servant of man? To answer these questions the Government hydrographic engineers are making their thousands of measurements annually and computing the results for the information of the public. At each Survey gaging station the height of the river is recorded daily. Then at frequent intervals with the river at different heights, the hydrographer visits the station and makes soundings across the stream bed every few feet so as to get a cross-section of the river bottom. With this cross-section of the body of water and the speed of the flow, usually obtained with an electric current meter lowered into the water, he can readily compute the number of cubic feet of water passing a given point per second. This flow, of course, varies greatly at different seasons. Variation is of the greatest importance in considering the river's flow for both irrigation and power. The low-water flow largely fixes the river's value in both cases. If for irrigation it must be known how much water can be depended on during the irrigation season, and if the water is to be stored in a reservoir the total annual flow must be determined. If for power the low-water flow largely fixes the value. If a factory is to be run by the power twelve months in the year then the two or three months of lowest water will measure the capacity of the plant. The fact that an ordinary flow may be a hundred times greater, as is the case in many rivers, will be of no importance, unless storage reservoirs are provided.

Because the Geological Survey has accumulated a

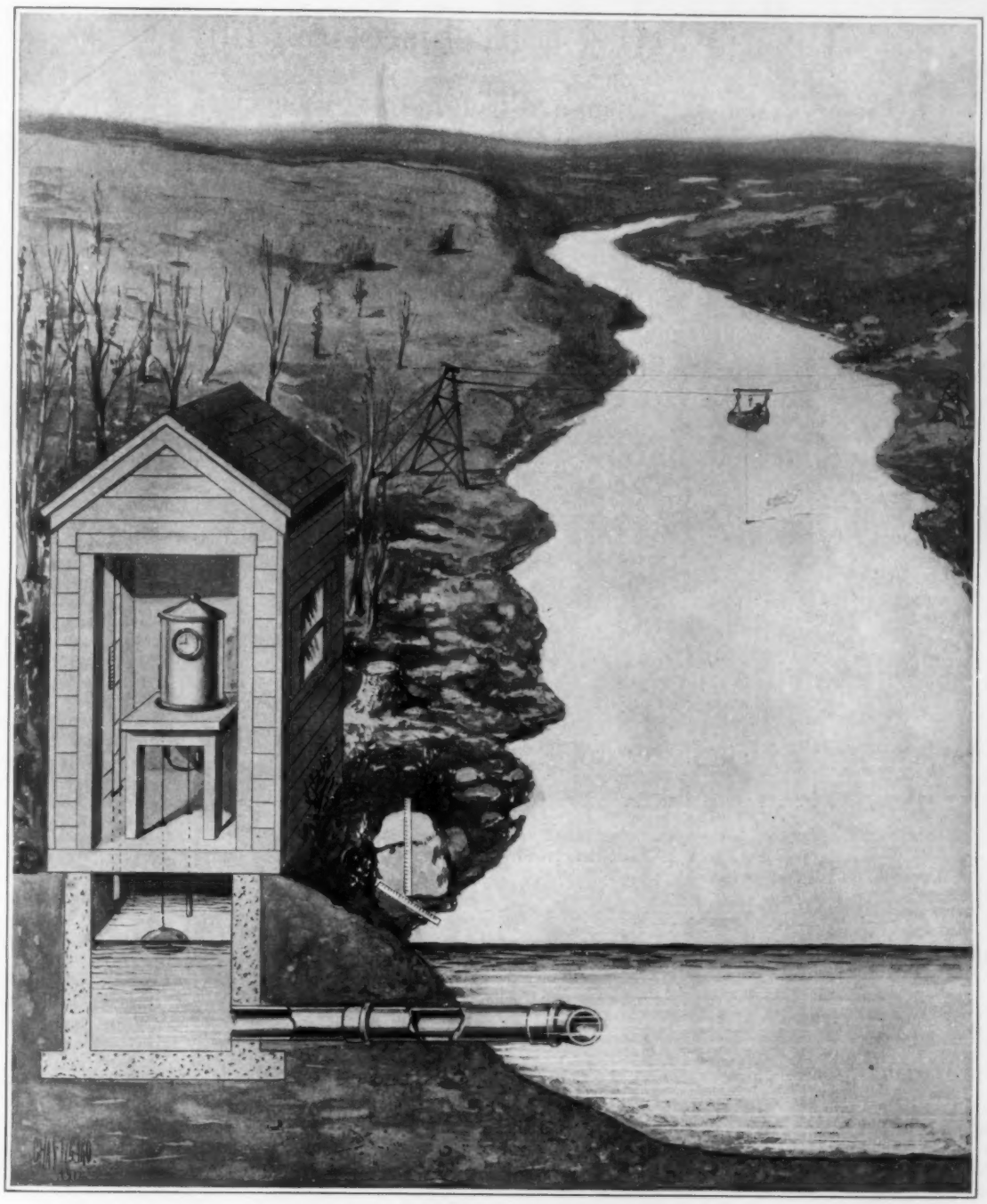


Long trolley line and car for measuring the volume of the Susquehanna River.

In rivers that are not too deep the gaging is done by wading in high rubber boots.

great amount of river data, the Government was able during the first year of the adoption of the present water-power regulations for the public lands to make withdrawals along ninety-seven western rivers, including thousands of water-power sites and involving millions of horsepower. To have acquired the information for these withdrawals specially for the purpose would have necessitated an enormous amount of field work, in fact, it could not have been accomplished in a single year with even an unlimited force and expenditure.

This stream measurement work of the Survey carried on throughout the West for many years prior to the passage of the irrigation law enabled the Reclamation Service to begin its construction work at once and to push it with a rapidity that was the astonishment and envy of visiting British irrigation engineers who had worked in India and Egypt. It is admitted that the integrity of these great irrigation works in the West, upon which over $70,000,000 is being expended by the Government, rests upon the hydrographic work of the Geological Survey. The formula for arriving at the horse-power in any river is a simple one. Multiply the volume of the stream flow in second-feet, i. e., the number of cubic feet of water passing a given point every second, by the fall of the river in feet and divide by 11. This will give the actual horse-power, which is 80 per cent of the theoretical horse-power. One second-foot equals approximately 7.5 gallons; thus if a small stream has a flow of 100 second-feet, or 750 gallons per second, and a fall of 50 feet, it will develop 454 horse-power.



Instruments in house give continuous automatic record of the rise and fall of a river which, in connection with the measurements made from the gaging car, furnishes data for computing the daily flow of the stream for every day in the year, or for any hour of the day or night.

But how is it possible, without a current meter or the services of an engineer, to make a rough estimate of the flow of a stream? First, make soundings across the stream, say, every 10 feet, and from this compute the number of square feet in the cross-section. Then to find the speed of the current, stake off a straight reach of 100 feet, and drop a piece of cork in the stream near the right bank. Note the time it takes to float the 100 feet between stakes. Repeat the operation from the opposite bank, and again for the middle of the stream. From these three find the average flow of the river per second. Multiply this by the square feet in the cross-section and the result will be an approximation of the volume of the stream in second-feet.

Thus, for example, a creek 50 feet wide has an average depth of 6 feet, the soundings showing 6, 8, 9 and 7 feet of water at the four 10-foot intervals, and, of course, 0 at either shore line. Adding these, 30, and dividing by 5 we get 6 feet of average depth, which, multiplied by the 50 feet of stream width, gives 300 square feet for the cross-section. Now the two corks dropped in near the banks each consume 100 seconds in floating the 100 feet, while the center chip floats the distance in 50 seconds. The flow of the shore water is thus 1 foot per second—an average for the stream of 1.33 1/3 feet per second. This multiplied by the 300 feet cross-section gives a stream flow of 400 second-feet. If this creek should be found to have a fall of 40 feet in a certain distance, say, a mile, it would be capable of developing 1,455 theoretical horse-power at 80 per cent efficiency.

Beautiful waterfalls by no means afford all the power possibilities of rivers. As much power can be extracted

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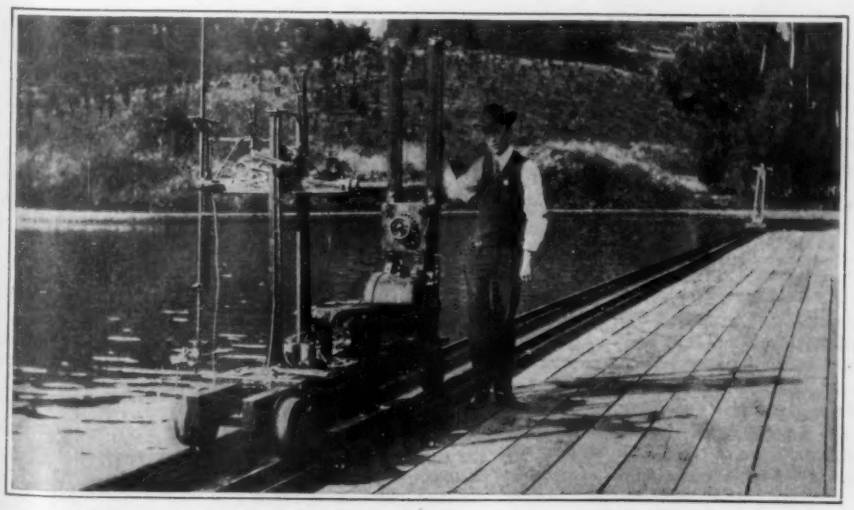


Where possible, railroad bridges are utilized for measuring streams at five- or ten-foot intervals.

Rock Creek, Washington, showing stream bed survey and method of gaging velocity every five feet, by electric current meter.

Plastic Art of Prehistoric Man

Clay Figures Modeled by an Artist of Twenty Thousand Years Ago

GRADUALLY our knowledge of our remote ancestor, prehistoric man, is increasing. And with our expanding information, we see ourselves forced now and again to materially change our point of view. There is a general tendency to credit some of the early inhabitants of our globe with much more advanced faculties than had formerly been supposed. And recent finds seem to indicate that in physical development, too, one type at least of very ancient man comes much nearer to his modern descendant than was hitherto believed.

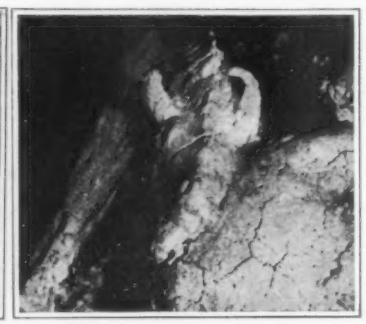
Public attention has recently been drawn to a discovery in the caverns at Tuc d'Audubert, Department of Ariège, France, which throws into the limelight the remarkable work of the prehistoric artist. The carvings, often very clever, of prehistoric man have long been known, and only recently we had occasion to describe the wonderful mural paintings of Altamira, in the Spanish Pyrenees. But more remarkable, perhaps, than any of these, are the clay-modeled figures of bisons discovered by Count Begouen in the cave of Tuc d'Audubert.

Some time ago the Count had found in this cavern prehistoric mural paintings of animals. In his further explorations, last October, he broke a way through a mass of stalactites, and, at the end of a gallery, over two thousand feet back from the entrance, he came upon clay figures representing a male and a female bison, in wonderful state of preservation, as our illustrations show. The two figurines lean against a boulder of rock which has fallen from the vault to the floor of the cavern. The foremost figure, a female, is thirty-two inches long, and measures eleven inches across the deepest part of the body. The corresponding dimensions in the male figure are each about one inch greater. The side of the body lying against the boulder has been left in the rough, unmodeled. While the cavern is fairly dry, and the clay is traversed by numerous cracks, by great good fortune the figures have been left otherwise almost intact. The only damage is that one horn and the tail of the female are broken off—the latter having been found in the floor of the cave. The surface of the figure has evidently been smoothed by the artist's hand, whose marks can still be distinguished. The eye of the female is made out of a clay-ball, with the pupil marked by a pit, giving it a very lifelike appearance. The male has merely a round, and somewhat lifeless eye. The beard is drawn in bold lines, evidently with a sharp stick or bone, while for the wooly mane the artist used his thumb, whose imprint can still be clearly distinguished.

Around the statuettes were found imprints of human feet and of bears' paws. The discoverer hesitates to move the figures from their original site, for fear of damage to them.

Where Count Begouen, breaking through a mass of stalactites, found the figurines.

Prepared by the prehistoric modeler, or modelers, but not used: Worked clay found on the floor of the cave.



These figures are said to be the first prehistoric clay figures discovered. The illustration on the left shows one of the bisons in side view. On the right is seen the splendidly modeled head, in front view.

Photographs by courtesy of the *Illustrated London News*

Possibly made twenty thousand years ago: The clay figures of two bisons found in the cave called Tuc d'Audubert, France.

Logwood of Commerce

THE imports of logwood into the United States during 1910 amounted to 32,368 tons, valued at $368,448. The largest quantity, more than one half, or 19,022 tons, came from Hayti, 11,187 from the British West Indies, and 1,005 tons from British Honduras. The remainder is derived from Mexico, Santo Domingo, and from the northern part of South America. Logwood was first shipped to England during the reign of Queen Elizabeth, but the unskilled dyers of her time found that it yielded a fugitive color, and so in the twenty-third year of her reign logwood was prohibited from being used under severe penalties. After a hundred years of prohibition from the English markets it was again allowed to be imported and used. It came into use in the United States during the middle of the eighteenth century, and at one time formed a much more extensive trade than it does at the present time.

The tree which produces logwood (Campeachy wood or *palo de campeche*) is botanically known as *Hæmatoxylon campechianum*. It often reaches fifty feet in height and sometimes from twelve to twenty-four inches in diameter. The wood is very hard, of a fine compact grain, a specific gravity greater than water, and is almost indestructible in contact with the soil and air. The pinnate leaves are handsome and of a fine dark glossy green color resembling those of the white thorn; the flowers are pea-shaped in fine yellow racemes.

The trunk is cut into large logs; the bark and the white sapwood is chopped off, because the dark red heartwood is the only valuable portion. After it has been chipped a little while it turns black, and if it lies in the water it dyes it like ink. Its value is in proportion to the size of the logs, the largest being the choicest kind. It is imported chiefly in short lengths, after which it is chipped or ground, and packed in casks and bags ready for the dyers', hatters' and calico printers' use, who esteem it very much, because it affords the most durable deep red and black dyes.

Logwood contains a peculiar coloring principle called hæmatoxylin ($C_{16}H_{14}O_6$), which forms an orange red solution with boiling water, becoming yellow as it cools, but recovering its former hue when heated. Alkali converts it first to purple, then to violet, and lastly to brown, in which case it seems to be decomposed. Metallic oxide unites with it, forming blue compounds. Gelatine throws down reddish flocculi. Stannous chloride renders it lilac.

Logwood shavings yield their color to water and alcohol; the latter extracts it more readily than water. The color of its dyes is red, inclining to violet or purple. Its aqueous decoction, left to itself, becomes yellowish, and at length black. Acids turn it yellow; alkalies deepen its color and give it a purple hue. The proper shades and colors are obtained by the use of aluminous mordants. A blue color may be obtained from it by the addition of verdigris, but the great consumption of logwood is for blacks, which are obtained by alum and iron bases, and of any requisite degree of intensity. Alcohol extracts most of the active principles of this wood and forms a deep colored tincture.

The cutting, barking, and transport of logwood constitutes an industry in nearly all parts of tropical America. The tree is indigenous to the forests of Tabasco in Mexico, to the lowlands, islands, and banks of rivers and lagoons, and gives employment to thousands. It forms one of the principal articles of export from that State. The Honduras logwood trade has been spasmodic of late years, although the dye it yields is superior to that obtained from the wood cut in Jamaica and St. Domingo. The Honduras and Yucatan wood sells for about $200 per ton, and the St. Domingo wood only for about $100 per ton. This is a very different price from that which was paid in the earlier days, when it was sometimes sold for $500 per ton. The Jamaica and St. Domingo wood is used in the dyeing of carpets and other coarse cloths, while the Central American is employed for dyeing all kinds of woolen, cotton, and silk fabrics.

Teaching Children Safety Principles

THE Brooklyn Rapid Transit Company has entered into an arrangement with the American Museum of Safety for a six months' campaign in the public schools of Brooklyn on the subject of safety in the streets of the borough. The American Museum of Safety has been working along similar lines in the borough of Manhattan for some time, and has in this matter the hearty co-operation of the Board of Education.

The Brooklyn campaign has been in process of planning for several weeks. As rapidly as the time of the two lecturers who are employed will allow, the system of instruction will be extended from school to school, until the entire borough is covered. It is estimated that in the four months which remain before the closing of the schools for the summer vacation most of the territory can be gone over. But the work will not stop with the summer vacation. It is planned to continue it in the vacation schools during the summer months.

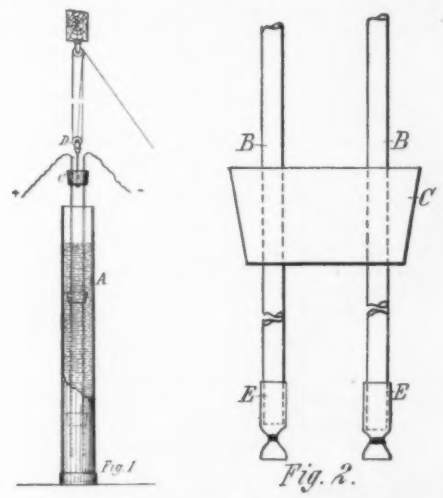
The basis of the campaign is furnished by the daily talks to the school children, followed up by the distribution of pamphlets, which the children are encouraged to take home and discuss with their parents. The talks themselves are illustrated by models which enable the lecturers to point out in a graphic way the correct and incorrect methods of boarding and alighting from street cars, and the handling of live wires and similar dangerous objects which may, through accident, be encountered in the public streets.

Cleaning Grimy Hands.—Automobilists who act as their own chauffeurs and mechanicians will be glad to learn of a practical process for quickly cleansing the hands of assorted and tenacious varieties of grime accumulated when adjustments or repairs are necessary. This process, as recommended in *Les Annales*, consists in a preliminary rubbing (twice repeated) with gasoline, followed by saturation, and rubbing with sweet oil or butter. The hands are finally washed thoroughly with soap and water, the nails being cleaned specially with a mixture of benzine and alcohol.

A New Type of Water Rheostat

By J. N. Clarke

THE ordinary form of water rheostat, having one electrode at the bottom of a wooden barrel, or similar non-conducting container, and the other electrode suspended in such a manner that it can be made to approach the bottom electrode, thus diminishing the distance between them and the resistance of the conducting electrolyte, has many disadvantages. In the first place, it is usually necessary to salt the electrolyte (water) to make it conducting enough for most purposes, and this gives rise to unpleasant products of electrolysis, making the rheostat odorous and dirty and often an unmitigated nuisance. Further, the resistance of this salted electrolyte is constantly changing as the electrodes are dissolved in the hydrochloric acid resulting from the passage of the current, so that a constant watch has to be kept of the adjustment of the upper electrode in case a constant current is wanted. And finally, but not least of all, such a rheostat does not give a constant gradation of current with the degree of immersion of the upper electrode, but gives a curve as that shown for "Common Water Rheostat" in Fig. 3. There is a considerable initial increment of current—the minimum resistance of the electrolyte—and after that, there is no considerable additional increment of current until the upper electrode is almost in contact with the lower, when the current value rises rapidly, making fine adjustments with the apparatus very difficult.



Water rheostat giving a smooth gradation of resistance.

To obviate these difficulties and also to secure an even increment of current for equal increments of immersion of the electrode over a long range, the following apparatus has been devised by the writer. It consists in its essence of a container *A*, which need not be insulating, the preferred form being a long 6-inch iron pipe, capped at the lower end; of two electrodes *B*, placed side by side and lowered together into the pipe *A* by means of some suitable gear, as for instance, the pulleys *D* and the cord, which may be run to a winch for hand raising and lowering of the electrodes. The two electrodes *B B* are of ¼ inch iron rod, thrust through 2-inch rubber corks, as shown enlarged at Fig. 2, and each of these rods is connected to an opposite side of the line. It will thus be seen that the electrolyte between the rods is that which resists the passage of current; and further, that the amount of current passing is exactly proportional to the surface of the rods in the liquid, which varies with the amount they are lowered into the liquid. This gives the smooth curve shown in Fig. 3, marked "Double Electrode Rheostat." Referring again to Fig. 2, which shows the cork at the lower ends of the rods, it will be noticed that to prevent a short circuit should the rods rest on the bottom of the containing tube, a piece of rubber tubing has been slipped over each one and tied with a piece of string.

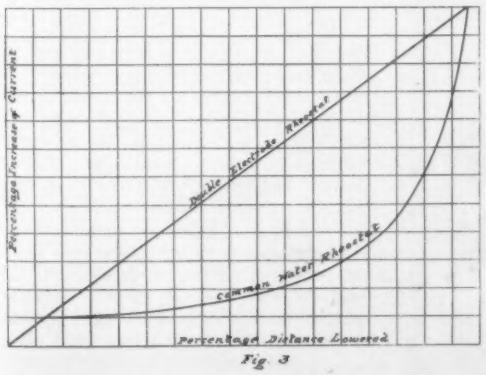


Fig. 3

Curves of the common and improved rheostats.

The advantages of this form of rheostat are numerous. In addition to its giving a smooth graduation of resistance without steps, it can be held constant at any point, as on account of the large surface of the electrodes exposed to the liquid, sufficient current can be forced through ordinary tap water without salting or acidifying it, with the result that the resistance of the electrolyte does not sensibly vary, and there are no unpleasant compounds formed, which ordinarily are so unclean in such a rheostat. Should it be found, however, that the water was not sufficiently conducting for the purpose in hand, caustic potash may be added drop by drop until the conductivity is obtained. Caustic potash is preferable to salt in that it will not attack and form unpleasant compounds with the iron.

This form of rheostat will be found very useful in many kinds of experimental work, and it is hoped that it will be of service to many experimenters who, like the writer, have long sought a reliable rheostat giving a smooth gradation of resistance over a long range.

The Effect of Static Electricity on Water

A NOVEL static experiment is illustrated in the accompanying sketch. The writer saw it at a popular science lecture, but it can easily be duplicated by the home experimenter.

A thin jet of water is arranged so that it shoots about ten feet up. The stream will be made up of fine drops at the farthest end. If now a hard rubber rod (the kind found in static experiment sets) is rubbed and brought near to the stream, the drops will immediately come together to form larger ones. The rubber rod should be held near the stream, and a few feet from the nozzle. The experiment illustrates how static electricity may account for large rain drops.

The apparatus comprises a rubber tube connecting to a water supply having some pressure, a jet which may be made from glass tubing, and which should have a small opening, so that the stream of water will be fine, and a rod which may be charged.

Controlling size of water drops electrically.

As variations, the use of a glass rod or a stream of oil is suggested. On a smaller scale, the effect of the charged rod on a thin stream of water from an ordinary faucet may also be tried.

Goniometer for Microscopes

By C. C. Kiplinger, Instructor of Science, Lincoln (Ill.) High School

THE manufacturers of microscopes rarely fit their low-priced instruments with rotating stages. Hence, the possessor of one of these otherwise efficient instruments is ordinarily unable to measure crystal and extinction angles.

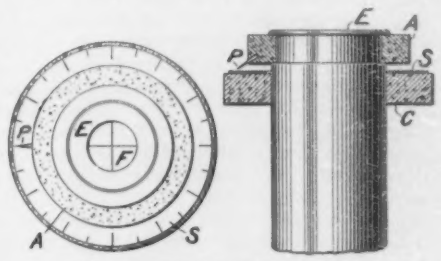
The goniometer here described is simple in construction and efficient in action. A ring, or flange, of cork, one quarter inch square in cross-section, should be cut of such internal diameter as to fit the eye-piece tightly. This ring should be blackened with a mixture of lampblack and shellac varnish. When dry, it is slipped over the eye-piece and brought to the position shown at *A* in the drawing.

Another cork ring *C*, cut so as to have a cross-section one quarter by one half inch, and tightly fitting the draw tube, is placed on it at *C*. This flange forms the support for a scale graduated in degrees. The scale is best made as follows: A large circle, at least a foot in diameter, is drawn on white card-board, and the degrees marked as accurately as possible. This scale is then reduced by photography to the required size, and a print is made on a "gas light" postcard. The print should be cut so as to fit the draw tube, and fastened to its cork support with a little shellac varnish, as indicated at *S*. A short piece of a pin or needle is pressed into the cork ring *A* at *P* to serve as a pointer.

The eye-piece must be fitted with cross hairs. A bit of silk thread is frayed out and several individual fibers obtained. The lenses having been removed, a bit of mucilage is put on the diaphragm at two diametrically opposite points. One of the fibers is stretched across the field at these points, using a splinter of wood to assist in the operation. Another fiber is fixed at right angles to the first, and their intersection made to coincide with the center of the field. The eye-piece is now assembled and the instrument is ready for use.

This piece of apparatus used in connection with the polariscope attachment described in the SCIENTIFIC AMERICAN of June 25th, 1910, page 524, will give the student of mineralogy or chemistry much satisfaction in the pursuance of petrographical research. It will be noted that this form of goniometer in operation does not disturb the optical center of the objective as regards the axis of the microscope.

The relative dimensions of small objects which are at the same distance from the center of the field may be estimated by turning the goniometer so that a certain cross-hair coincides, first with one edge and then the opposite, and noting the angular magnitude. The dimension to be measured should be perpendicular to the hair which passes through its terminus. This being the case, the tangent of the angle involved is the measure of the dimension. Since, for angles less than fifteen degrees, the tangents vary approximately as the angles themselves, the angles which these small objects subtend are measures of their relative diameters. Thus used, the goniometer becomes a tangent micrometer.



Goniometer for microscopes.

A Direct Current Motor from a Telephone Ringer

By Guy Hubbard

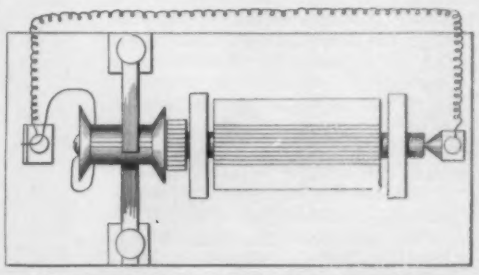
A VERY good experimental electric motor, which is reversible and has a speed reducing gear, may be easily made from an old magneto telephone ringer. The ringer is an alternating current dynamo, having brushes, which rub on the ends of the armature shaft. This shaft is in two sections and is insulated from the armature by a core. The ends of the armature coil are soldered to these sections.

In order to change the machine into a direct current motor, a commutator must be put on. The conditions are different from those in a common motor. The commutator is made from a small spool. The sections are of thin brass and should be each a little less than half the circumference of the spool. Short lengths of wire should be soldered to the ends of these, and after fitting them to the sides of the spool they are fastened with a rubber band snapped around them.

The brush on the gear end of the magneto is loosened and turned around. A small hole is punched in it and adjusted so that it is on a line with the center of the armature shaft. There is a tapered hole in this end of the shaft. The commutator is fastened on by a wood-screw, which fits the spool and is somewhat longer. The threads are filed from the end of it so that it fits this hole tightly. The commutator is adjusted with its open spaces exactly opposite the centers of the channels of the armature. The wire from one of the sections is bent over the end of the spool, and is twisted around the head of the screw. The commutator is then tightened by a few raps of a hammer.

The brushes are narrow strips of thin brass fastened to small wooden blocks. Each of them should be fitted with a binding screw. These are fastened on each side of the commutator and adjusted to rub on the commutator or at points exactly opposite.

The wire from the other section is bent around the end of the spool and placed in the hole in the contact strip, so as to run smoothly when the armature is turned. The contact strip, which rubs on the shaft, and the one with the hole in it, are connected by a wire. The machine will now run at good speed when a strong battery is connected to the brushes. The armature will have to be started unless in a certain position, as it is a two-pole machine.



Motor constructed out of a telephone ringer.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

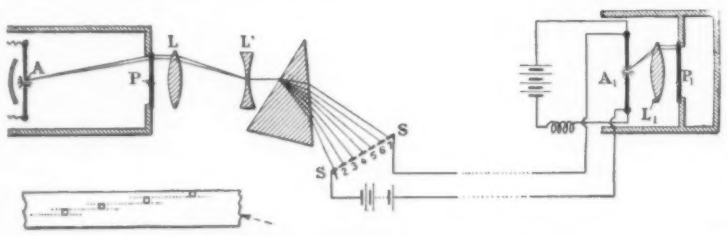
The Marino System of Color Telephotography

IN a recent number of *Lumière Electrique*, M. Marino explains his system of telephotography in black and white and in colors. Selenium is of course used, as in most telephotographic systems. It will be recalled that in the Korn process, the transmitting element is a selenium cell, selenium being a metal the electrical resistance of which is a function of the luminous intensity to which it is subjected at any given moment. Marino employs not one cell, but a battery of seven cells, each responsive to a single color—red, orange, yellow, green, etc. In transmitting pictures in black and white each cell responds to the particular radiation to which it is sensitive. In transmitting pictures in colors they transmit the fundamental hues of the original, decompose them at the transmitting station, and recompose them at the receiving station.

At the transmitting station the photographic plate *P*, the colored picture on which is to be transmitted in black and white, is illuminated by an electric arc *A*. Each ray of light after passing through the plate falls upon a convex lens *L*, by which it is refracted to the concave lens *L'*, by which in turn it is thrown on a prism. The prism analyzes the ray into its fundamental spectrum colors, and the various colored rays in turn fall upon the corresponding selenium cells S^1, S^2 .... S^7. The cells are so mounted that rays of a particular color will always fall upon the proper cell. The cells are included in the line circuit leading to the receiving station. Their total conductivity is equal to that of a single cell receiving composite light. The effect produced at the receiving station, because of the variable conductivity of the entire battery of transmitting cells, is proportional to the amount of light received from any point of the original image at a given moment.

The original photograph is decomposed point by point by regularly displacing across the photographic plate an opaque ribbon perforated with very fine holes, arranged in step-like series so that the upper edge of the second lies at the level of the lower edge of the first, etc., as shown. Each perforation as it passes across the plate permits the passage of a horizontal band of light from the arc behind the plate. The horizontal distance between two consecutive holes or perforations is such that one perforation at a time passes across the plate, and that an appreciable interval is allowed between the exploration of the plate by the two ribbons. During this interval the selenium cells are at rest and are thus enabled to lose their residual conductivity, which they tend to preserve as the result of a well-known effect of inertia or hysteresis. Because the intensity of the light is distributed among all the selenium cells, each receiving but a part of the light resolved by the prism, the hysteresis is considerably diminished.

At the receiving station a short length electric arc *A'* is to be found, to which a very weak direct current is supplied. The arc is connected with the line circuit and hence with the selenium cells. The variations in resistance of this circuit have a very marked effect on the luminous intensity of the arc, although that effect is not noticeable to the eye. These variations in light fall on a photographic plate *P'*, in front of which an opaque ribbon pierced with holes or openings identical with those of the transmitting ribbon is displaced synchronously with that of the transmitting station. The sensitive plate is affected in such a manner as to reproduce the original together with all the gradations in color and tone.

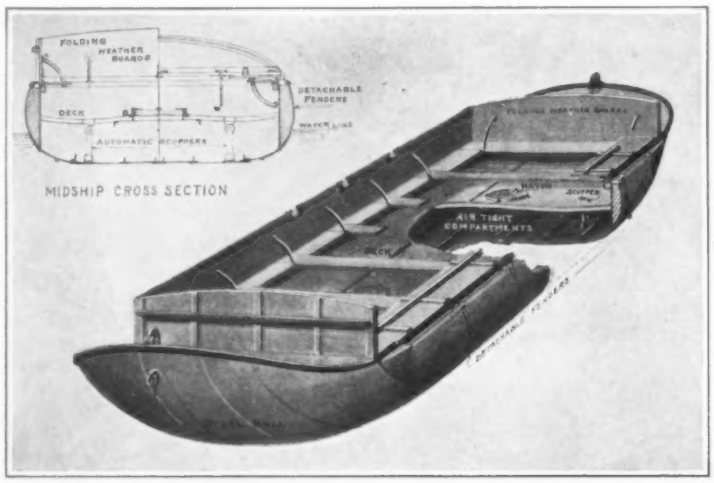


The Marino system of telegraphing pictures in colors.

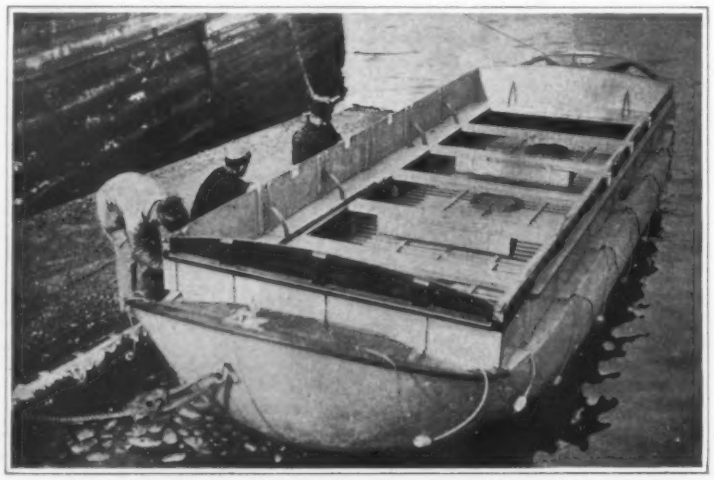
It is of course practicable to transmit not only a colored photographic transparency, but also the image of any fixed object reflected by a mirror. The perforated ribbon passes over the reflection exactly as in the case of the photographic plate.

In transmitting photographs in colors the seven cells of selenium instead of being mounted in parallel on a common circuit, are divided into three groups, each of which form part of a circuit of a Poulsen arc, generating waves of varying length. At the receiving station three wave detectors included in three resonating circuits (each of which has a frequency corresponding with that of one of the set of waves emitted by one of the Poulsen arcs) influence three receiving arcs, in front of which colored filters are mounted corresponding with the three groups of selenium cells. The three sets of colored rays emanating from the three arcs are concentrated by lenses on a sensitive autochrome plate, explored in the manner already explained, by an opaque perforated ribbon, so that each point is allowed to exert its influence, while at the same time the corresponding point of the original is illuminated by an opening in the perforated ribbon of the transmitter.

By superposing the impressions made by three sets of colored rays, the shades and intensities of the original are exactly reproduced in their proportionate intensities. When the original has been completely explored by the perforated ribbon the receiving plate has completely responded. Developing is the next step.



How the Lundin lifeboat is constructed.



Detachable fenders prevent staving of the hull.

Lundin boat undergoing a Government test.

The Lundin Decked Lifeboat

IT is now almost a year since the urgent necessity for revising regulations referring to life-saving appliances at sea was brought home with terrible force to the public mind through the sinking of the "Titanic." Since that cruelly unnecessary loss of life, inventors and boat-builders have been active in devising boat construction which would meet all the new requirements made by the Board of Supervising Inspectors and make it possible to carry three times as many boats as formerly constituted the equipment of an ocean liner, without encroaching unduly on the deck-promenade space.

Before the general adoption of wireless stations on ships, those who were forced to betake themselves to the boats in case of disaster, might expect to sail about for days before reaching land or being picked up, but now, with many more ships passing back and forth in the prescribed lanes of convenient navigation, help can reasonably be expected to arrive within a few hours, and it is, therefore, merely a question of having means to keep everybody afloat under fairly comfortable and safe conditions until the rescuing vessel appears on the scene. If this means of keeping afloat can also be propelled and maneuvered as readily as the standard type of life-boat, it is of course an added advantage, and if it is practically impossible to overturn it or dent and damage it by smashing against the side of the ship, we may say: The ideal life-boat is found.

The Lundin decked life-boat seems to answer to this description perfectly, as was demonstrated recently in exhaustive tests made at Newport News and San Francisco by the United States Army Transport Service, and only a few weeks ago by the Board of Steamship Inspectors, when they visited New York for the purpose of looking into the merits of various marine life-saving appliances.

The boat consists of a decked hull with the sides extending above the deck some 15 inches. Folding weather boards of a substantial construction are hinged to the top edge of the sides and may be raised in a second, automatically locking themselves in the upright position. Similar boards are then raised at the ends, and the boat is ready for lowering.

The boat is divided into eight watertight compartments by transverse bulkheads, which carry the deck above the load waterline, thereby making the boat self-bailing by means of scuppers through the bottom in each compartment. A manhole is also provided in each compartment to allow for inspection and painting.

On each side a large fender is carried, made of a very buoyant material (Balsa wood), which is so treated that the buoyancy is permanent.

These boats carry the regular ocean-going equipment, including mast, sail, and rigging, and can be rowed or sailed as readily as the ordinary type of life-boat; furthermore, they are well adapted to being towed, which is a consideration of some importance, since it is the intention to carry some motor-equipped life-boats on large passenger carriers.

This life-boat is rated with a co-efficiency of 0.9 as compared with a rated co-efficiency of 0.6 for ordinary life-boats, and has 25 per cent more carrying capacity for a given length.

Two of these boats may be stowed on each other, or nested, without risk of damage under one pair of davits, and it is easy to compute what a saving in deck space this represents.

The Decision in the Wright Aeroplane Patent Case

ON February 27th, 1913, Judge Hazel, in the District Court of the United States for the Western District of New York, handed down a decision upholding the Wright patent in the case of the Wright Company v. Herring-Curtiss Company and Glenn H. Curtiss. All the elements in the Wright machine were conceded to be old. The question at issue was: Were the Wrights the first to discover that the vertical rudder of a flying machine must be used in conjunction with wing-warping devices or ailerons in order to prevent the machine from spinning on a vertical axis? The Court held that they were, and that Curtiss had infringed the patent in which that discovery is described and claimed. The decision is too long for republication in its entirety; but the following abstracts will give the average reader all that he need know.

There are eighteen claims in the Wright patent, but only claims 3, 7, 14 and 15 were held to be infringed. They read as follows:

"3. In a flying machine, a normally flat aeroplane having lateral marginal portions capable of movement to different positions above or below the normal plane of the body of the aeroplane, such movement being about an axis transverse to the line of flight, whereby said lateral marginal portions may be moved to different angles relatively to the normal plane of the body of the aeroplane, and also to different angles relatively to each other, so as to present to the atmosphere different angles of incidence, and means for simultaneously imparting such movement to said lateral marginal portions, substantially as described."

"7. In the flying machine, the combination with an aeroplane, and means for simultaneously moving the lateral portions thereof into different angular relations to the normal plane of the body of the aeroplane and to each other so as to present to the atmosphere different angles of incidence, of a vertical rudder, and means whereby said rudder is caused to present to the wind that side thereof nearest the side of the aeroplane having the smaller angle of incidence and offering the least resistance to the atmosphere, substantially as described."

"14. A flying machine comprising superposed connected aeroplanes, means for moving the opposite lateral portions of said aeroplanes to different angles to the normal planes thereof, a vertical rudder, means for moving said vertical rudder toward that side of the machine presenting the smaller angle of incidence and the least resistance to the atmosphere, and a horizontal rudder provided with means for presenting its upper or under surface to the resistance of the atmosphere, substantially as described."

"15. A flying machine comprising superposed connected aeroplanes, means for moving the opposite lateral portions of said aeroplanes to different angles to the normal planes thereof, a vertical rudder, means for moving said vertical rudder toward that side of the machine presenting the smaller angle of incidence and the least resistance to the atmosphere, and a horizontal rudder provided with means for presenting its upper or under surface to the resistance of the atmosphere, said vertical rudder being located at the rear of the machine and said horizontal rudder at the front of the machine, substantially as described."

It was contended for the defendant that the Wrights merely improved the known gliding machine, and that the wing tips, horizontal rudder, and vertical rudder were old separately and in combination. But the Court could find no similarity between the constructions of Lilienthal, Pilcer and Chanute on the one hand and the Wrights on the other.

The Court analyzed the prior patents cited as anticipations against the Wrights, but failed to find that they revealed the Wright principle.

The Henson British patent of 1842, the Maxim patent of 1889, the Lanchester British patent, the patents to Crepar and Johnston, the Herte British patent of 1870, the famous Mouillard patent (No. 582,757), and the Boulton British patent of 1868 were all rejected as complete anticipations of the Wright invention. None of these patentees had in mind the principle that the steering or control of the machine depended upon the tilt of the wings in connection with the use of the vertical rudder.

Importance was attached to the revived Mattulath application for a patent, dated January 8th, 1900, but the Court thought there was "an utter failure to show that the catamaran-like structure of 180 feet over all and revolving disk 40 feet in diameter, with its decks, compartments, and machinery, was complete, or that it was even remotely possible to reduce it to practice, and without such showing it is devoid of material significance. Even assuming that it belongs to a prior art, the structure is not provided with movable side ailerons simultaneously adjustable, or a movable rudder, but has a fixed rudder which has no connection with the ailerons."

One additional publication, the Ader article, published in France in 1893, was dwelt upon. Ader's apparatus somewhat resembles the wings of birds or bats, having tips which could be moved forward and backward. As our readers know, the machine was of the monoplane type, and carried a motor, "but," said the Court, "as there was no connection between the warping features and the rudder by which the lateral balance of the machine was secured, the publication is not entitled to be considered in limitation of the claim in suit embodying such elements."

Continuing, the Court states: "A summary of what had gone before in aerial machinery unmistakably discloses, first, publications which did not contain descriptions of apparatus of such clearness and definiteness as to enable the skilled in the art to construct therefrom an operative device, or clearly suggesting ways or means to solve the problem of lateral balance. . . . I am of opinion, after complete consideration of the testimony on both sides, that the patentees by their method of securing the equilibrium of the planes made an important advance in an embryonic art. They were not the first to conceive the idea of using monoplane or biplane surfaces for flying, nor the first to support two planes at their margins one above the other, or to use vertical tails or rudders for steering, or to plane horizontal rudders forward of the machine to guide it upward or downward in its flight. The prior separate use of such elements is freely admitted by the patentees, but they assert, rightly, I think, that the patented combination was a new combination performing a new and novel result. The antecedent patents, the efforts to perfect the gliding machine and to provide means for restoring equilibrium, in short, the many unsuccessful attempts to remedy existing imperfections in aerial machinery, all bear witness to the fact that the achievement of the patentees required the exercise of the inventive faculty. Having attained success where others failed, they may rightly be considered pioneer inventors in the aeroplane art. Their concept was practical, and their combination of old and new elements meritoriously advanced the operativeness of aeroplanes of this type from which astonishing flights have resulted."

There was much discussion at the bar as to claim 3, which does not include the vertical rudder as an element. The important feature of the claim is that the lateral marginal portions of the planes must be capable of movement to different angles relatively to the normal plane of the aeroplane and about an axis transverse to the line of flight, the purpose of said movements being to present to the atmosphere different angles of incidence. It was argued that without the co-operation of the vertical rudder the claim was wholly impracticable. The Wrights contended that there is shown a sub-combination which is valid and which should be sustained. There is evidence that the marginal ends of the supporting planes are capable of moving simultaneously in different angular relations to the plane and to each other without the assistance of the vertical rudder, but the result was not satisfactory, as the machine in its flights skidded to the side, an imperfection which has been remedied by the use of the vertical rudder in conjunction with the ailerons. So the Court held that "it is not essential to the validity of claim 3 that all parts of the machine, or all parts specified in other claims, which are necessary to its operativeness should be included therein, and resort must be had to the specification for a disclosure of the parts necessary to insure the practicability of a patented device. In the Wright structure a new and novel result was attained simply by having the ailerons on the ends of the planes without the supplemental feature of the vertical rudder. The warping feature is, in fact, the essential part of the machine, while the vertical rudder insuring successful flying is a valuable adjunct without which lateral balance could not be restored. The employment, in a changed form, of the warping feature or its equivalent by another, though better effects or results are obtained, does not avoid infringement."

Is there in a Curtiss machine a tendency to spin or swerve which is checked or counteracted by the operation of its vertical rudder?

The Court answered thus: "If I am correct in my interpretation of claim 3, and the rule of law applicable thereto, the ailerons of defendants' construction and the manner of using them are within its scope. The witness, Curtiss, frankly testified that the purpose thereof is to preserve the lateral balance 'without the use of any other element or part,' it making no difference whether the aeroplane is in a straight or curved flight. Such concession supports the infringement of the claim under consideration."

"The defendants are believed to have appropriated the substance of claim 7, and to have infringed claim 14, inasmuch as in addition to the essential elements of the Wright patent and the object with which such elements are used, they also employ in their aeroplane a horizontal rudder for 'presenting its upper and under surfaces to the resistance of the atmosphere.' Claim 15 contains the essential elements and specifies that location of a vertical rudder at the rear of the machine and a horizontal rudder at the front thereof.

"The defendants have embodied in their aeroplane the various elements of the claims in suit. While it is true, as pointed out herein, that the defendants have constructed their machine somewhat differently from complainant's and do not at all times and on all occasions operate the same on the Wright principle, yet the changes they have made in their construction relates to the form only. They have constructed their machine so that it is capable of restoring equilibrium in substantially the same way as is complainant's machine, and the evidence is that on occasions, depending upon aerial conditions or other disturbing causes, they use the vertical rudder not only to steer their machine, but to assist the ailerons in restoring balance."

The decision marks the first important victory for the Wrights in this country in their effort to uphold their patent. Both German and French courts have handed down similar decisions.

Notes for Inventors

A Combined Snow Plow and Shovel.—In patent No. 1,049,812 Frank Darling of Plano, Ill., presents a combined snow plow and shovel, which has blades so connected with each other and with a handle that they may be shifted to form either a plow or a shovel as may be desired.

Collapsible Drinking Cup.—Henry W. Bowman of Barboursville, Ky., has patented, No. 1,049,199, a collapsible drinking cup in which a strip of material is bent to form a spiral coil serving as the wall of the cup and has a handle which co-operates in holding the cup collapsed when not in use.

A Macbeth Lantern Globe.—Patent No. 1,048,981, to George A. Macbeth of Pittsburgh, Pa., has for its subject a lantern globe of glass upon the edge of which a protective metal sheath is formed by electroplating metal upon the edge of sufficient thickness to protect the edge from chipping.

Another Spring Wheel for Automobiles.—Harper E. Stratton of Empire, O., in a patent, No. 1,049,418, presents a vehicle wheel in which spring bow-shaped spokes extend in pairs between the hub and the tire or rim and wedge blocks are interposed between the inner ends of the spokes and seated in recesses in the hub.

A Number of Gas-burner Patents.—Edwin G. VanZandt of St. Louis, assignor to VanZandt Gas Appliance Company of the same place, has secured patents Nos. 1,045,464 and 1,045,465 for gas burners, a patent, No. 1,045,466, for a gas grate and patents Nos. 1,045,467 to 1,045,475 inclusive for gas burners varying in structure.

Help for Swimmers.—A swimming glove is shown in patent No. 1,049,448, to Hoy P. Chase of Stockton, Cal., and includes in connection with an ordinary glove having a hand and finger portions, a suitable web which is secured to the tips of the glove fingers and extends over the back of the glove and is stitched at a point near the wrist in such manner as to form a pocket between the web and the back of the glove.

Match Splints from Pulp.—Co-operative Syndicate of New York city as assignee of Warren B. Hutchinson of Newark, N. J., has secured a patent for a match machine by which match splints are formed from pulp, the pulp being separated into separate strips or splints and a series of grooved heated rollers being utilized to shape the splints, the splint forming members after leaving the rollers being cut off into suitable individual splint lengths.

A Motor-controlling Mechanism.—Charles R. Pratt of Montclair, N. J., in patent No. 1,048,999 provides a motor-controlled mechanism in which there are a number of motors with means which maintain a predetermined relative speed of the motors in connection with a brake and means operating by differential gearing between the motors for applying the brake, the mechanism for operating the brake being thus dependent on a variation in the relative speed of the motors.

Assorting Fruit by Weight.—In patent No. 1,048,963, John B. Hart of Austin, Colo., presents a machine for grading fruit in which there is a series of scales for assorting fruit of different weights and means are provided for conducting the fruit to the scales so that in the operation of the scales the heaviest specimens of fruit will be dropped first and the lightest specimens will be dropped last, thus securing a grading of the fruit by the weight of the respective specimens.

Honors to Berliner.—Mr. Emil F. Berliner of Washington, D. C., whose long line of important inventions beginning with his telephone improvements and extending through the graphophone and sound reproducers, have made him famous as an inventor and who of late years has devoted much time and energy to philanthropic work, has received the Franklin Institute gold medal for his work toward the betterment of living conditions, the medal being one of six given annually. Mr. Berliner had already received, by the recommendation of the Franklin Institute, the Scott medal in bronze from the city of Philadelphia.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

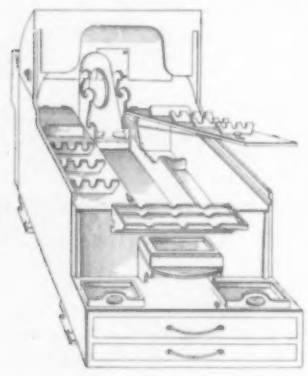
Of General Interest.

BERRY BOX FORMER.—W. H. ELLIS, Cœur d'Alene, Idaho. This invention relates particularly to formers for berry boxes which are shipped flat and are folded into box form just previous to use, and has for an object the provision of an improved structure which will permit the quick folding or assembling of berry boxes of various sizes without breakage or distortion.

UNDERCUT SAW GUIDE.—J. W. DONAHUE, Pe Ell, Wash. This saw guide is adapted to so support the saw as to form a kerf at the under side of the log, with the saw inverted. Devices of this character include generally a spike or dog to be driven into the side of the log, and a guide arm adjustable on the shank of the spike and carrying a friction roller forming a rest and guide for the inverted cross-cut saw.

RECORDING INSTRUMENT.—A. F. BENSON, care of Messba Eng. Co., Virginia, Minn. This invention relates to instruments for determining the dip and bearing of drill holes, and from which permanent photographic records may be obtained of the existing conditions encountered as the instrument is lowered down into the drill hole.

CABINET FOR DESK IMPLEMENTS.—G. DE LA TORRE, 4a de Recabado, No. 109, Mexico, Mexico. This invention is an improvement in cabinets for portable use, adapted to hold the materials and the utensils used in writing, as for instance, paper envelops, pen and ink and



CABINET FOR DESK IMPLEMENTS.

the like, so arranged that all of the materials and utensils may be held in a relatively small space, making an easily portable cabinet. The illustration shows a perspective view of the improved cabinet open.

SYRINGE HOLDER.—G. GIORDANO, Turin, Italy. The present invention relates to syringe holders, and the object of the invention is to provide a spring controlled syringe holder, so arranged that the use of syringes for injections by any person is rendered easy without inconvenience.

METALLIC PARTITION.—A. H. LEVENE, Rochelle Park, N. J. The object of the invention is to provide a new and improved metallic partition for use in offices, stores, and other places, and arranged to permit of readily assembling the parts in a correspondingly short time, and to render the partition exceedingly strong and durable.

CONTAINER AND DISPLAY DEVICE.—W. W. BAGLEY, R. 327 Knickerbocker Theater Bldg., 1402 Broadway, New York, N. Y. The invention pertains generally to a display device adapted, when in knock-down position, to serve the purpose of a container, the construction being made up of folding parts of simple construction, whereby an efficient structure may be produced at a trifling cost.

SUPPORT FOR CONCRETE REINFORCEMENTS.—C. A. KOERNER, 511 Walker Bldg., 5th and Market Sts., Louisville, Ky. This invention pertains to means for supporting concrete reinforcements, and has for an object to provide a structure which not only supports the reinforcements at the desired place, but acts as tying means for connecting the various parts together.

MEDICINE DROPPER.—C. F. HYDE, 4103 State St., Chicago, Ill. The intention in this case is to provide a bottle which is more effective for its purpose than those commonly employed and which will be substantially air-tight when not in use as a dropper, so that the contents of the bottle will be properly preserved.

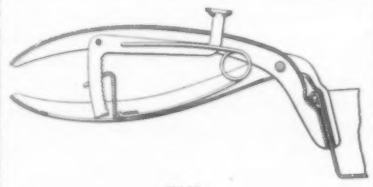
NON-REFILLABLE BOTTLE.—S. FISCELLA, 1645 Lexington Ave., New York, N. Y. This invention relates generally to non-refillable bottles, and the principal object is to provide a device of this class which will be extremely simple, and, at the same time, adapted to be substantially non-refillable, whereby a commercially successful article may be set forth.

AQUARIUM ATTACHMENT.—H. A. ROGERS, Pagosa Junction, Colo. The invention relates to aquarium attachments, and it has for its object to provide convenient means for supplying the aquarium with air, and for establishing a circulation of water therein which may be readily removed from the aquarium tank, and be cleaned.

NON-REFILLABLE BOTTLE.—W. H. BOCK, Corona, Queens, New York, N. Y. A stop is provided near the lower end of the neck, to which the device is connected, and a valve structure arranged above the stop. This structure is formed with a freely reciprocating valve member actuated by gravity and also by the flow of liquid in either direction, the flow in one direction causing the valve to be unseated for allowing the fluid to flow from the bottle, the fluid flowing oppositely causing the valve to be seated against the action of gravity, whereby liquid is prevented from entering the bottle. Arranged between the valve structure and the outer end of the bottle are a plurality of baffling members, stops, etc., which prevent tampering with the valve structure.

Hardware and Tools.

TOOL.—J. STURTEVANT and J. T. WEINZIERL, 1106 3rd Ave., New Kensington, Pa. This invention is more particularly intended for embodiment in detachable handles for cooking utensils, but is capable of embodiment in



TOOL.

pliers and other gripping devices. A spring between the crossed handles of a pair of gripping jaws tends to close the jaws; a novel ratchet and spring pawl on the handles hold the jaws in closed position.

DRILL EXTRACTOR.—W. L. HATZEL and T. STOETZEL, care of Theo. Stoetzel, 1526 Vyse Ave., Bronx, N. Y., N. Y. This invention has reference to drill extractors, and has for an object the provision of an improved structure for engaging broken drills or drills of any kind, and quickly removing the same from the hole or bore in which they are found.

LUBRICATOR FOR HANDSAWS.—T. RICHARDSON, 2016 Perdido St., New Orleans, La. This inventor provides a lubricator and oil cup for handsaws and similar tools and is arranged to insure proper oiling of the saw blade and to allow convenient and quick attachment of the lubricator to the saw blade or to allow removal therefrom.

Heating and Lighting.

BOILER.—A. P. LINK, 237 President St., Brooklyn, N. Y. Mr. Link's invention refers to boilers, his purpose being to improve the general efficiency of apparatus of this kind; the object of the invention being to facilitate the capture and removal of mud or other residuum from within a boiler.

Household Utilities.

SHADE ROLLER.—G. R. GRIGG, care of The Anderson Mfg. Co., Coffeyville, Kan. The object here is to construct a shade which may be accurately and readily adjusted in place without the use of any screws or nails or any other attachments. Further, to so construct and arrange the shade that it may be placed in any position on the framework of the window, so as not to interfere with the opening of the window for ventilation or other purposes.

SHADE ROLLER SUPPORT.—W. COCKCROFT, 185 So. 4th St., Brooklyn, N. Y. This invention has reference more particularly to a shade roller device, which comprises an elongated member, a bracket adjustable longitudinally of the member and having means for supporting a shade roller, and a clamp associated with the bracket and adapted to secure the same in different positions along the member.

DEVICE FOR LOCKING AND UNLOCKING WINDOW BLINDS AND DOORS.—J. C. PEPPERS, P. O. Box 539, Beaumont, Tex. An object of this improvement is to provide means for opening a locked door or window blind from the sidewalk, especially in the case of fires, these doors or window blinds generally being bolted on the inside, thereby preventing the firemen from gaining access to the different floors of the building.

SHOWER BATH APPARATUS.—J. E. LANGLEY, 230 Stonen Ave., Shreveport, La. The purpose here is to provide a metal, economical portable, extension shampoo and shower attachment, with practically no wearing parts, one that can be closed so as to permit of being carried in an ordinary suit-case, easily and quickly attached to any standard combination hot and cold water cock, and extended to provide for the desired bath.

CLOTHES LINE.—D. J. LAHAY, care of J. E. SAGER, Coleman, Wis. This improvement provides a line having means incorporated in the construction for holding articles of laundry for drying; provides means for holding said articles at suitably close intervals; minimizes the weight of construction of the line; and minimizes the cost of construction of the same.

WASHBOARD.—W. O. DALY, care of Lerio Turpentine Cup Co., Mobile, Ala. The purpose here is to provide a construction of washboard in which the rubbing surfaces will be reinforced and can be readily removed and replaced, the whole being constructed to furnish a board which can be conveniently supported for use.

OPERATING DEVICE FOR WINDOW SASHES.—P. F. FITZ GERALD, 239 Bainbridge St., Brooklyn, N. Y. This invention provides a device for window sashes, arranged to enable the operator to readily raise or lower the sashes one independent of the other and without much physical exertion on the part of the operator, to securely hold the sashes in their adjusted position and to permit them from sticking or canting while being raised or lowered.

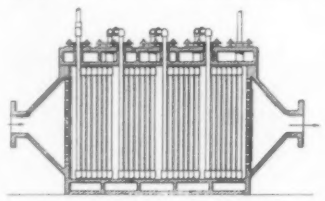
Machines and Mechanical Devices.

STAVE JOINTER.—J. J. KROHN, care of Humboldt Cooperage Co., Arcata, Cal. This invention relates to automatic machines for jointing barrel staves. The machine will automatically joint the edges of the barrel-staves in such a manner that narrow and wide staves shall have the proper bevel at their edges. The feeding means prevent substantial lateral movement of the staves during the cutting operation.

TRANSMISSION MECHANISM.—T. P. STEADMAN, care of State Savings Bank, Elsie, Mich. The invention relates to a power transmission mechanism for generators or wherever a positive uniform drive is desired from a spasmodic or non-uniform drive. An object is to cushion the sudden acceleration of spasmodically rotating members to, in effect, store the unevenness of power, so that it may afterward be utilized over a long period of time, which in the case of the generator will produce a steady even current.

MACHINE FOR USE IN THE MANUFACTURE OF INCANDESCENT GAS MANTLES.—J. I. ROBIN, 121 Bollo Bridge road, Acton, London, England. This invention has more particular reference to a machine for finishing mantles formed upon the machine forming the subject matter of Mr. Robin's co-pending application, Serial No. 585,992, of which this application is a division. The object is to provide an apparatus whereby the half complete mantles formed by the machine may be readily and rapidly completed without necessitating the use of skilled labor.

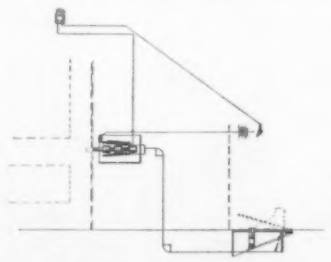
AIR COOLER FOR AIR COMPRESSORS.—H. E. MACCAMY, care of Union Iron Works, Spokane, Wash. This invention provides a device for cooling air in which a greater surface of air is exposed to the cooling device. This



AIR COOLER FOR AIR COMPRESSORS.

is attained by means of a perforated partition and a series of pipes which are so disposed as to break up the air into minute particles, at the same time causing these particles to pass into contact with the cooling surfaces.

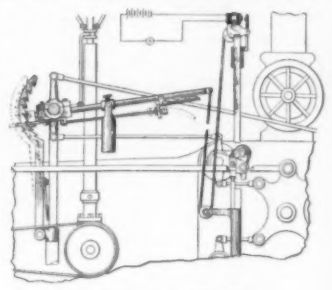
AUXILIARY LOCK FOR DOORS.—A. SATZMAN, 1890 Third Ave., Manhattan, New York, N. Y. This invention provides means whereby a door may be secretly locked in closed position and from a distance, to prevent the unauthorized exit of a person from a room without knowledge of one in authority; provides means for operating a lock and releasing it in the presence of a person and without his



AUXILIARY LOCK FOR DOORS.

knowledge; provides an audible alarm operable by the lock when closed, and means for operatively controlling the alarm; and provides a durable mechanism for operating the lock. During warm weather when the door is open there is an attachment that closes the door and permits the lock to operate in the door. As a protection during the night in case anyone should enter the store and trespass near the safe the lock automatically locks the door, thus preventing the person's escape besides giving an electric bell alarm outside the store.

CONTROL FOR ENGINES.—H. J. PARCHMAN, Box 692, Anacortes, Wash. This invention relates more particularly to manually controlled mechanism which comprises a member having means whereby the admission valve may be so adjusted as to vary the speed of

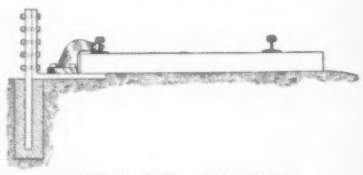


CONTROL FOR ENGINES.

the engine from the normal to a complete stop without closing the throttle valve or adjusting the governor. In connection with a magnet the engine may be stopped completely from any desired place without closing the throttle valve of the engine, and the governor can be made more sensitive when the engine runs normally.

Railways and Their Accessories.

RAILWAY RAIL ATTACHMENT.—W. HASKINS, 35½ Chestnut St., Hartford, Conn. This attachment serves not only to prevent the rail from shifting laterally or canting, but also to support the cross-ties. To this end the invention consists of a post having its lower portion embedded in concrete and projecting a substantial distance above the ground, an angle-plate on which one end of the adjacent cross-tie seats, bolted or otherwise attached to the upper portion of the post and seating on the ground, and an elbow attached to the angle-plate and to the rail web.



RAILWAY RAIL ATTACHMENT.

CATTLE GUARD FOR ROADWAYS.—J. A. STEPHENSON and S. J. BILLINGTON, care of Billington & Anderson, Elliston, Mont. The invention provides suitable bars and a yielding apron adapted for disposition in pathways which could be traveled by cattle, which apron and bars would operate to trap or discompose cattle on trying to cross the same; and provides a bar structure quickly and readily arranged or mounted in service position.

Pertaining to Vehicles.

RESILIENT TIRES FOR WHEELS.—E. L. A. OLIVIER, 17 Place de la Madeleine, Paris, France. This invention relates to an improved resilient tire for vehicle wheels of all kinds, which comprises two circular bands of rings placed the one around the other, and connected together by a cover of rubber or other similar resilient material under tension.

AUTOMOBILE PUMP.—R. A. GOETH, P. O. Box 199, San Antonio, Tex., R. B. Rodgers and J. A. Dittmar, San Antonio, Texas. An object of this invention is to provide a pumping attachment, which is attachable to any wheel regardless of the size and form of the hub, or the absence of any projection of the hub beyond the face of the wheel. A further object is to provide means so designed as to permit of securing the attachment to such wheels as are provided with large brake drums.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9301. Wanted the names and addresses of a few concerns who can do machine embroidery according to the design furnished, at reasonable rates.

Stereoscopic Views of Lightning

(Concluded from page 265.)

lightning has, we believe, been photographed only once, though there are many pseudo-photographs of this phenomenon.

Two years ago, Prof. B. Walter of Hamburg published in the Year Book of the Scientific Institutes of that city several double views of lightning obtained with a stationary and a mechanically moved camera, respectively. These double views were mainly intended to ascertain the time connection between atmospheric discharges occurring at different points of the sky, though practically at the same moment. In working out these views, a want was frequently felt for learning not only the time connection, but the space relation of such "correlated" flashes of lightning, which induced Prof. Walter to utilize in his recent researches not two, but three photographic cameras, one of which was as formerly moved by clockwork, whereas the two remaining were fast on a wooden lath at about 2 meters distance, being adjusted with their axes parallel to one another by means of two graduated circles.

As pointed out in a paper submitted to the recent Congress of German Naturalists and Physicians, the views taken by means of the last-named two cameras, one of which is shown in Fig. 1, allow the distance of each lightning flash from the observer to be ascertained. Furthermore, each of these pictures, in conjunction with the third one, viz., the picture obtained with the movable cameras (Fig. 2), will give any time difference between the various discharges. On the other hand, the two pictures obtained with the stationary camera, provided the difference between the latter bears a proper ratio to the distance of lightning flashes, are very well adapted for stereoscopic inspection.

Some excellent pairs of stereoscopic pictures of this sort have been obtained in the course of last summer, and as these would seem to be the first of their kind, one is reproduced in the accompanying figures (Figs. 3 and 4), while the correlated picture, obtained with the movable camera, is shown in Fig. 5.

On examining Figs. 3 and 4 in the stereoscope, those branches which in each individual picture cross one another are seen to be entirely separated in space, and accordingly, to be entirely independent branches of the main flash. Stereoscopic inspection also shows that in the present case, far behind the strongest left-side ramifications of the main flash, another self-contained flash of lightning has occurred whose origin in the cloud is readily found, which has turned to the left in order, it seems, to terminate in another cloud. From the dimensions of the original picture, the distance of the main flash of lightning from the observer is found to be about 500 meters, and that of the flash of cloud lightning several kilometers. That the latter really is a discharge entirely independent of the main flash of lightning is, by the way, borne out by the third picture of the phenomenon, the one obtained with the movable camera (Fig. 5), the main flash of lightning being practically instantaneous, while the cloud lightning is made up of two partial discharges, with maxima following up one another at 0.0905 second interval. By comparing the third view with the two stereoscopic pictures, the main flash of lightning is found to coincide to less than 0.001 second with the last partial discharge of the hindmost cloud lightning, thus proving with nearly absolute certainty an electrical connection between two discharges entirely independent in space.

Life-boat and Deck-seat Combined.—A novel form of deck-seat is shown in the patent, No. 1,049,513, to Thomas J. Murphy of Needles, Cal., and consists of a boat-like structure which may be turned upside down to provide seats back to back with the back of the seat formed by the stationary keel of the boat, a sliding keel being connected to the stationary keel so it may be readily adjusted to position for use when the deck-seat is inverted in the water.

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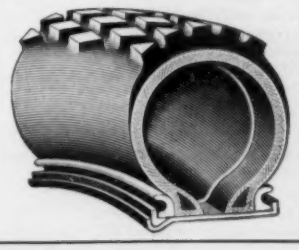

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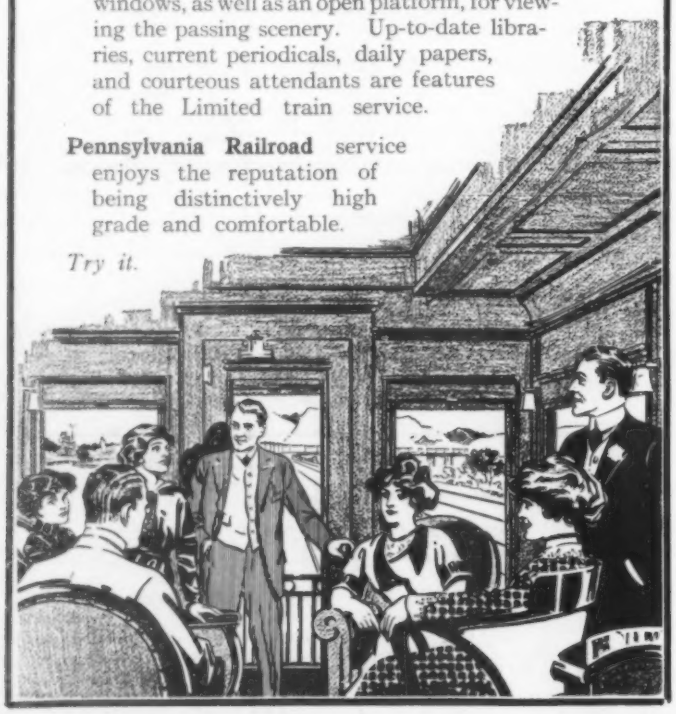

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1940—Aluminium Solders, gives several formulas in use when aluminium was almost a new thing in the arts.

1644—Soldering and Soldering Processes, gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use.

1667—Some Soldering Appliances, describes the blow-pipe and the furnace in their various forms.

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Gasoline and Its Substitutes

A Great Problem and Its Solution

THE price of automobiles is going down but the price of gasoline is going up. The wholesale price in New York is now 17 cents a gallon. A year ago it was 9 and 10 cents, but rose to 16 cents by July, 1912. The relation of kerosene to gasoline has been strikingly reversed. In former years there was so little demand for gasoline that it was an almost valueless by-product in the mineral-oil industry, and therefore as much as possible was left in the kerosene. This, however, increased the explosibility of the latter and the consequent danger of its use. States passed laws to safeguard the lives and property of their citizens by prescribing the flash point and burning point of kerosene, and it was the duty of the State-oil inspectors to see that the kerosene offered for sale came up to the required standard.

At the present time gasoline is worth about twice as much as kerosene and now it is gasoline that is adulterated with kerosene.

The United States is fortunate in having great oil fields within its borders, being excelled only by Russia in this respect. In other countries the situation is more acute. Gasoline in Germany sells for 40 cents a gallon. The International Association of Recognized Automobile Clubs has offered a prize of $100,000 for a fuel which may be used as a substitute for gasoline, and a British Society one of $10,000.

Relief may be found in any one of three ways:

1 By increasing the gasoline supply.

2. By devising apparatus—carbureters—capable of utilizing other fuels such as kerosene, naphthaline, crude oil, vegetable oil, alcohol, etc.

3. By compounding or discovering a new fuel which can be used in the engine just as gasoline is now used, i. e., without any substantial modification of the engine or its carbureter. It is toward the solution of the last stated problem that the prize above mentioned has been offered.

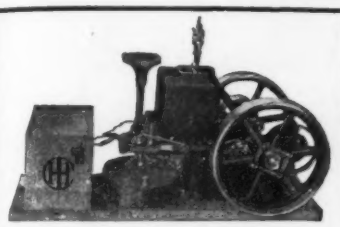
For a better understanding of the gasoline question it may be briefly stated that crude petroleum, by a process of fractional distillation, may be separated into a multitude of component oils differing from each other in insensible gradations. The aim is to produce the maximum yield of three principal products for which there is the greatest demand, these being kerosene of 43 to 47 deg. Be. gravity, naphtha of about 42 degrees gravity, and automobile naphtha, or as it is now more commonly called, gasoline of about 68 degrees gravity. Kerosene, naphtha and gasoline constitute about 60, 4 and 10 per cent respectively of the crude petroleum. However, due to the unsettled state of the nomenclature of the mineral oils, these products sometimes go under modified names, particularly the "gasolines," which are to-day extensively sold under gravities considerably less than has been customary some years past. However these products may be named, the fact remains that they, as ordinarily found in commerce, are really unseparated mixtures of higher and lower gravity oils, their components being so proportioned that the average gravity corresponds to the gravity of kerosene, gasoline, and the like.

Leaving out of consideration the opening up of new oil fields, other sources of gasoline have been searched for. An interesting source of gasoline and process of recovering it is as follows:

As well known, natural gas is found in enormous quantities in some of the oil regions. Now this natural gas contains a small quantity of naphtha vapors. Naphtha may be defined as including all hydrocarbons, and each of them, which are liquid at ordinary temperatures and atmospheric pressure, and which have lower boiling points than the normal hydrocarbons of burning oil (kerosene). The natural gas may be said to be carbureted with naphtha. While this quantity of naphtha, as stated, is small, and the amount varies in the gas from different oil wells, yet in the aggregate a large quantity of naphtha is daily burned as fuel along with the other constituents of natural gas. In order to recover this naphtha the gas is first cooled and then passed through absorbing towers where it comes in intimate contact with descending streams of a "menstruum." For the latter the following substances may be used; hydrocarbons whose boiling point is separated by a considerable temperature interval, say 100 deg. Fahr. from naphtha, fatty oils, amyl alcohol and others. The naptha thus absorbed is separated from the menstruum by fractional distillation. If the absorbed naptha is to be separated otherwise than by distillation from the menstruum enriched thereby, a menstruum must be used capable of such separation. Such are ethyl alcohol sufficiently anhydrous, acetone, mixtures of acetone and methyl alcohol. These absorb naphtha and on dilution with water part with it. Therefore it is only necessary to add water to the menstruum saturated with naptha, whereupon the naphtha will separate out as a supernatent layer which is decanted off.

Another method of producing gasoline is by converting kerosene into gasoline. The oils, it should be recalled, are hydrocarbons belonging to the paraffine series corresponding to the formula $C_n H_{2n}+2$. Kerosene is composed of a mixture of the higher members of the series, gasoline of the lower. Now if a reaction like the following ($C_{12}H_{26}=C_5H_{12}+C_6H_{14}+C$) could be effected, which means that one molecule of a higher member is broken up into two molecules of lower members, splitting of some carbon as residue, the problem would be solved, provided the process could be carried out commercially. Now this very process, called "cracking," is carried out in breaking down the members above the kerosene members, by superheating them in the distillation process. The yield of kerosene is thereby increased. Unfortunately the breaking down of the lower members of the series into still lower ones appears to offer greater difficulties. However, a patent has recently been granted for a process of converting kerosene into naptha or gasoline by subjecting the kerosene to the powerful influence of properly applied decomposing temperatures, ranging from a visible or cherry red to a full white heat. The heat is applied by means of a submerged electric heater. An electrode of heat-enduring material, submerged near the surface of the oil is maintained at an incandescent temperature by a low-voltage, high-amperage electric current. The vapors evolved are withdrawn and condensed. The condensed distillate contains a mixture of light oils and heavier still, unconverted oils. They may be separated by fractional distillation, or the mixture may be subjected to successive treatments with the electric heater. This process of "cracking" the heavier oils relieves them of more or less carbon, which is deposited on the hot electrodes and partly held in suspension and gravitating toward the bottom of the converter.

The use of kerosene, crude oil, even vegetable oils as a substitute for gasoline, offers comparatively little difficulty in engines that operate on the hit or miss principle, that is where a uniform charge of air and oil is drawn into the explosion chamber of the engine. But in the automobile engine, where the charge is controlled by the throttle valve, far greater demands are made on the carbureter to furnish the most desirable mixture of oil vapor and air for varying conditions of speed and load. The problem of devising a reliable efficient carbureter is greatly complicated when it is proposed to use kerosene, crude oil, paraffine, napthaline, etc. The latter two are solid at ordinary temperatures and must therefore first be liquified. Carbureters designed to use such fuel have been patented, but whether they will operate as successfully as their inventors claim, remains to be seen. It is well known that kerosene may be used after having started and warmed up the engine with gasoline It will be found, however, that kerosene soon causes trouble through carbon deposits in the engine. This is due to the



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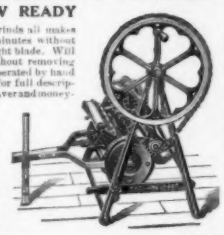

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"cracking" of the kerosene caused by the high ignition temperature. It is proposed to overcome this difficulty by injecting a small quantity of water along with the charge. The water is converted into steam, thereby lowering the initial temperature and preventing the "cracking" and the consequent carbon deposit. But it is obvious that the necessity of the water injection again complicates the problem of the carbureter.

The compounding of a new fuel resembling gasoline in its physical properties must meet the following demands: Its exhaust gases or products must not attack the cylinder; the explosion must not be too violent; it must leave no solid residue; and last but not least it must be cheaper than gasoline and the supply of its base or main ingredient must be so abundant that even an enormous demand therefor will not raise its price to any extent. The last requirement rules out with one sweep all vegetable and animal oils and fats. This would confine us to hydrocarbons and their derivatives obtained from mineral oils, distillation products of carbonaceous material, coal tar, alcohol, etc.

In Germany industrial alcohol, being lower in price than gasoline, the latter selling at 40 cents, is used as a base for the new fuel. In this country industrial alcohol has not as yet realized in any measure the high hopes entertained at its introduction. As it is considerably higher in price than gasoline it offers no prospect of being of any aid in the solution of the gasoline question. Several patents have been granted in Germany covering interesting and suggestive processes. One proposes to increase the power and explosibility of alcohol by the addition of mono nitro-benzol. Another process is to dissolve a small quantity of acetylene gas, as little as 0.2 to 0.5 per cent of acetylene by weight of the new fuel mixture being sufficient to increase its power and explosibility considerably. At 0 deg. Cent and 760 millimeters atmospheric pressure, gasoline absorbs 4 to 5 per cent of acetylene, kerosene 1.5 to 2 per cent, alcohol 5 to 6 per cent, and acetone 30 per cent. Therefore, using acetone saturated with acetylene for dosing the fuel base, such as alcohol or kerosene, the desired result is obtained, acetone being miscible with the mentioned fuel bases.

A new process, recently patented in Germany, is still more promising. A mixture of alcohol, kerosene, coal tar oil and coal tar is distilled at a high temperature. Thirty-six parts of the resulting distillate, 100 parts of 94 to 95 per cent alcohol, 2 parts of distilled wood spirits—all parts being by weight—are distilled between 66 to 70 deg. Cent. until no more vapors pass over. About 12 per cent of the mixtures is thus distilled over. The remaining 88 per cent is cooled to 10 deg. Cent. About 8 per cent of paraffine and naphthaline are thus precipitated out and removed by filtration The remaining liquid constitutes an alcohol highly carbureted, which contains neither substances excessively explosive nor those which precipitate out in the cold. For automobile use 64 per cent of this resulting liquid is mixed with 36 per cent of the light distillate obtained in the distillation at 66 to 70 deg. Cent. This new fuel, it is claimed, is an excellent substitute for gasoline.

Measuring the Flow of a Stream

(Concluded from page 269.)

theoretically from a reach of river ten miles long having an even gradient of 5 feet to the mile, as from a clear drop of the river of fifty feet at one point, although in rare instances, owing to the topography of the river banks it may be cheaper to extract power from rapids than from a straight fall.

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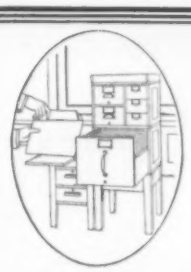

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The Chemistry of a Soldering Flux

THE action of a flux during the operation of soldering consists, briefly, in cleansing the surfaces to be soldered, keeping them clean, and letting the solder make contact with them.

The impurities generally occurring on metallic surfaces are grease or other organic matter and oxides. An effective flux must have the power of dissolving all those and flooding them out of the way.

Zinc chloride is the flux most commonly used. It fuses upon the surface at a low temperature, and dissolves organic matter with great readiness. It removes oxides by converting them to chlorides of low melting points, which flow out of the way, either alone or in solution with the fused zinc chloride. The chloride of iron even volatilizes to a considerable extent. Zinc chloride is usually applied in water solution. But its flowing power and its cleansing action are increased when it is used in solution in some alcohol, fatty acid, or oil, such as oleic acid or castor oil. With all these solvents it combines in large proportion to form thick, syrupy liquids with high boiling points. The cleansing action is improved by the solvent, which dissolves metallic oxides and chlorides.

Ammonium chloride in solution in glycerine is frequently used as a flux, and is especially suitable where a very clean job of soldering is necessary, since these materials are driven off by heat and leave very little residue. The action upon organic impurities is not so strong as that of zinc chloride, but the glycerine flows very readily, and readily dissolves the chlorides formed by decomposition of the ammonium chloride, so that this mixture is a very effective flux.

Of the organic fluxes, rosin is perhaps the one most commonly used. It is most effective for soldering tin and lead surfaces. It owes its efficacy in cleansing to its ability to form soluble resinates with tin and lead oxides. Similarly, various oils and fatty acids, such as palm and castor oils, oleic and stearic acids, have value as cleansing agents and make good fluxes.

The physical properties of a material also determine its usefulness as a flux. Its viscosity should be light enough at the melting temperature of the solder to permit of a free flow on the surface. Its surface tension in contact with the heated surfaces and melted solder should be quite high. This is a vital characteristic. That is, these surfaces should not be easily "wetted" by the flux. The importance of this may be seen by comparing the fluxing power of a petroleum oil with that of rosin. It will be seen that the mineral oil wets a globule of melted solder completely, while the rosin shows a negative tendency. The oil forms a film which separates the solder from even a clean metal surface, while the rosin film breaks, lets the solder touch the metal, and even draws the two together.

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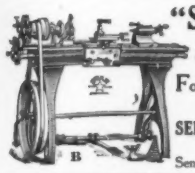

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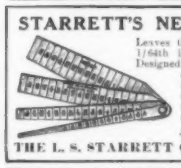

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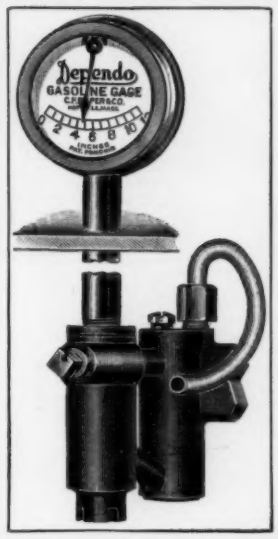
(12759) J. F. M. asks: Will you please advise me as to what chemical action takes place when a volume of gas is exploded by an electric spark? A. A volume of gas which can be exploded by an electric spark must be a mixture of the oxygen of the air with some combustible gas. The spark of electricity starts the combustion, and the fire spreads quickly through the whole mass.

(12760) L. S. asks: The usual explanation, that it is the attraction of one body for another, does not explain anything. What I wish to know is whether gravitation is a force apart from other forces or whether it is electrical (magnetic) or something of the sort, and whether it is supposed to act instantly at all distances or has a definite rate of travel. A. The nature of gravitation is unknown. It exhibits itself as an attraction between the particles of matter. It is different from and acts apart from other great forces of nature, electricity, magnetism, etc., and it acts instantly, not flowing with a velocity which would require time for it to cover a space. 2. What is evaporation? My theory is that most liquids and some solids are soluble in air and other gases, just as solids are soluble in liquids. Am I right? I have looked in vain for a satisfactory explanation of the above questions. Can you put me right? A. Evaporation is the passing of the molecules of a liquid or solid into the vapor state. Air is not necessary for evaporation. It takes place with much greater rapidity in a vacuum. Some solids evaporate in a vacuum which will melt in the air. Air retards evaporation. Evaporation is explained by the kinetic theory of matter—that the molecules of all liquids are in vibration; those at the surface for this reason can escape from the surface, and then are vaporous. Heat and not solution explains evaporation. See Carhart's "College Physics," which we send for $2.40 postpaid.

(12761) C. P. L. writes: In your issue of December 21st, 1912, in answer to inquiry 12717, by J. A. B., I note your explanation with reference to the electrolysis of water, and the jocular manner in which the subject is handled. Water, that is, H_2O, is extremely difficult to ionize, and the inability of pure water to conduct electricity is caused by the fact that it is the ions only which conduct the current, and I venture to state that it is not the ions of the water which appear at the respective poles as gas. I should be pleased, therefore, to see a more correct explanation, or to be shown wherein the following explanation is wrong: When sulphuric acid is added to water, the substance produced is dilute sulphuric acid. As such the ions are those of sulphuric acid, viz. H_2 and SO_4. Now, the SO_4 ion, which carries a negative charge, gives up this charge upon contacting with an unattackable positive electrode. Immediately it recombines with a molecule of water to form H_2SO_4 (sulphuric acid), thus liberating the atom of oxygen from the molecule of water with which it has become associated. At the negative pole, the diluted sulphuric acid has the SO_4 ion repelled, as it carries a negative charge, and the H_2 ion, carrying the positive charge, gives up its charge, and the gas appears as hydrogen. The hydrogen, having given up its charge, cannot recombine with the SO_4 to form sulphuric acid. A. We thank you for your letter and the interest you take in the completeness of the answers in Notes and Queries. It would, however, have defeated our end if we had made an answer to the correspondent in question and given an explanation of the electrolysis of water which involved sulphions, the lack of ionization of chemically pure water, the primary and secondary electrolysis, etc., which are involved in this phenomenon as explained by the latest theories. He would be repelled by this method, and would turn away from the paper in disgust, since he emphatically asked us not to give a technical explanation. Only a brief abstract of the letters are usually printed in the form of questions, and very often the personality of the questioner is lost in the condensation of his views. We have to decide how far we shall go in a particular answer, as we were in this instance. If we were disposed to criticise the statement above, we should find it as open to criticism as was ours. We should take decided exception to the claim that the oxygen and hydrogen which appear as gases do not come from the water. They cannot come from the acid, for that is not used up in the electrolysis, and the water is used up. They can only come from the water, though they pass through the acid on their way. Nor should we say that the sulphion recombines with a molecule of water. It displaces the oxygen of the water, and takes its hydrogen to form a new molecule of sulphuric acid, and in turn gives it up in ionization; so that the ionization is continuous, and both hydrogen and oxygen *molecules*, not atoms, as the letter says, appear at the two poles. We are quite willing to give our esteemed correspondent his opportunity to teach this inquirer, but after all think our mode of stating the case to be the better for the beginner, and that, too, after many years in the professor's chair teaching this subject to students.



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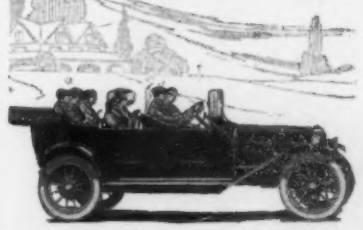

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